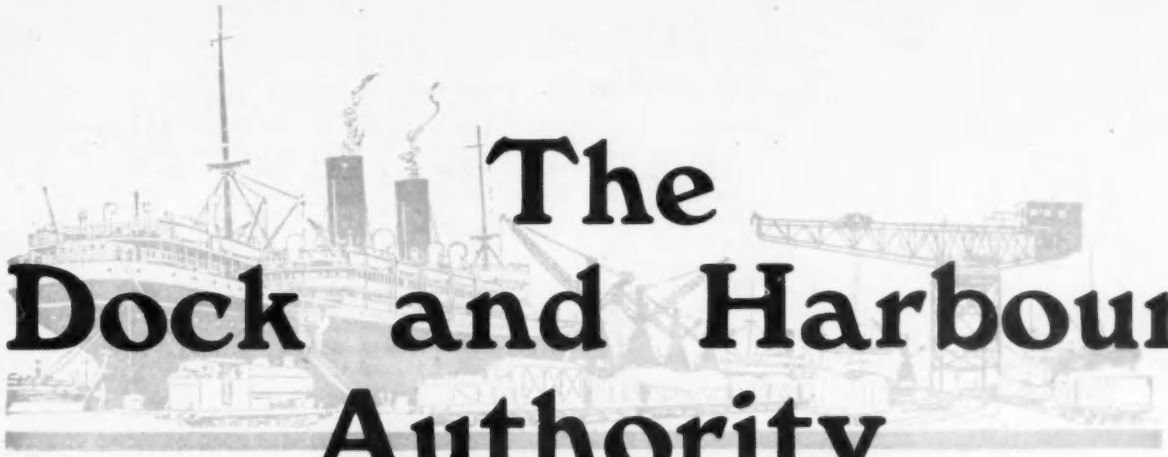


The Dock and Harbour Authority

No. 270. Vol. XXIII. Edited by BRYSSON CUNNINGHAM, D.Sc. B.E., F.R.S.E., M.Inst.C.E. APRIL, 1943

CONTENTS

EDITORIAL	269	THE WEST INDIA DOCKS, LONDON	281
THE PORT OF ASTORIA, OREGON, U.S.A	271	MODEL PROTOTYPE CONFORMITY	282
TACOMA NARROWS BRIDGE	275	THE GLAMORGANSHIRE CANAL	284
NOTES OF THE MONTH	276	NOTABLE PORT PERSONALITIES	284
NOTES ON DRAG-SUCTION DREDGING	277	RANGE-ACTION IN HARBOURS	285
LEGAL NOTES	280	HISTORY OF THE STOCKTON SHIP CANAL	287
MERSEYSIDE DOCK ACCESS	280	INFLUENCE OF HARBOURS ON FISHERIES	289

Editorial Comments

A Pacific Coast Port

After having perused, in recent issues, articles on such well-known ports, as Bristol and Trieste, with their world-wide trading connections and extensive shipping ramifications, our readers may find it an agreeable change to pay some attention to a relatively little known (at any rate in this country), but active port on the Pacific Coast of North America. Astoria, located on the left bank of the Columbia River, in the State of Oregon, U.S.A. and the only fresh-water seaport along the coast, is linked with the Pacific Ocean by a ship channel, 10 miles in length. Its commerce up to the present has been mainly local, consisting largely of shipments of canned salmon, which is one of the leading industries of the town, though latterly, the packing and exportation of tuna has been added to the port's fishing activities.

During the 10-year period terminating in 1938, just before the war, the water-borne commerce of the port averaged rather less than 400,000 tons per annum, and as the foreign portion was represented by only 10 per cent. of this, it can be seen that there is ample scope for development. It is, of course, a matter for surmise how far the situation has been affected by the war; but, as no information is available, there is nothing that can be said on the point. The report on the port accommodation and shipping facilities, prepared so carefully and with such exactitude by the United States Board of Engineers for Rivers and Harbours, on which the article in this issue is based, shows that there are undoubted possibilities in the future which may bring Astoria to the front, though it will find a powerful competitor in the neighbouring port of Portland, which has established itself in a strong position, as can be seen from the article devoted to that port which was published in the November, 1942, issue.

The Merseyside Dock Access Committee.

The announcement by the Ministry of War Transport of the appointment of a Committee to consider the conditions of access and the development of transport facilities on Merseyside at the Port of Liverpool will be welcomed as a wise and judicious step, since the successful operation of a port depends as much on the convenience of its landward accessibility as on the nature and extent of its berthage accommodation. Many ports have been hindered in their development by inconvenient and inadequate shore approaches, and it will be within the recollection of our readers that, some few years ago, the Port of London Authority had to grapple with the problem in connection with the improvements effected to their Royal Docks system. This happened to be a particularly difficult case, with serious delays and interruptions to traffic at railway crossings, and at swing bridges over lock entrances and passages at road level. The problem was solved by the construction of a high level approach, though, as was to be expected, it was a somewhat costly undertaking.

At Liverpool, the docks lie along a narrow strip of river frontage, which can only be reached at various points by relatively small and narrow streets, the gradients of which are more or less steep. It is true that there is ample warehouse accommodation within easy cartage distance, and that the system of lorry transport to and from the local warehouses has long been a characteristic feature of the port. There is room, however, for considerable improvement in shore traffic arrangements and the Committee will be rendering a valuable service to the community in devising a scheme of roadway approach to the docks which will ensure expeditious transport between the quayside and the inland collecting and distributing agencies of the port.

An Historical Occasion at the Port of London.

One hundred and forty-three years after it was originally embedded in position, the memorial first stone of the West India Docks and Warehouses at the Isle of Dogs, near Limehouse in the Port of London, has been unearthed, opened and its contents disclosed to view.

The proceedings in connection with the ceremonial opening are described on another page. In the present comment, we propose to refer to the circumstances under which the dock and warehouse system in question was inaugurated. A very detailed account is given by Sir Joseph Broodbank, in his classic *History of the Port of London*. He points out that the Act of Parliament for the making of its West India Dock was the first legislation of its kind in this country. The Act was passed in 1799. In its preamble it recited that owing to the progressing size of ships, the dangerous navigation of the River Thames, the lack of space for manœuvring and the resultant losses, it would be beneficial to make a " canal " across the Isle of Dogs. The Lord Mayor and Council of the City of London were accordingly authorised to make a " canal " with all the appurtenant works. Recounting that ships in the West India trade frequently arrived at the port in large fleets, it was further stated that it good and sufficient wet docks were

Editorial Comments—*continued*

made in the Isle of Dogs with legal quays and warehouses, not only would additional room and much accommodation thereby be given to the rest of the shipping using the port, but that the valuable West India produce would be effectually secured from loss by theft from which and fraud, it had greatly suffered.

A period of five years was assigned for the construction of the docks and the directors of the undertaking were empowered to build such and so many quays, wharves and warehouses as they should consider necessary and convenient for the " landing and discharging, lading and shipping of any goods, wares or merchandise that shall or may at any time or times be legally landed or shipped at the said quays or wharfs." The docks were opened in 1802.

The management of the undertaking was an experimental essay beset with special and novel problems, since no other port system at the time afforded a suitable precedent, on account of the extensive warehousing business involved. A large part of the Act accordingly relates to the regulation of the dock and warehouse activities into which, however, it is unnecessary to enter here.

Although we have indicated that the West India Dock System was an enterprise without precedent, it was by no means the pioneer of dock undertakings. The credit for the creation of the first wet dock in Great Britain belongs to Rotherhithe on the Surrey side of the Thames, where the Howland Great Wet Dock was completed about the year 1700, though the actual date is not known and the priority of the dock has been disputed on behalf of the Old Dock at Liverpool, which dates from somewhere about the same time, but probably a year or two later.

However that may be, the West India Docks are of quite respectable antiquity and possess a record of useful service which can be parallelel by few other docks in the country. During the long period of their existence, the docks have afforded berthage to numerous famous ships, in turn sailing, steam and motor propelled, with cargoes of the most diverse description, aggregating millions of tons in weight and millions of pounds in value. Latterly, the docks have undergone reconstruction and transformation to meet modern requirements and this re-modelling should enable them to carry on their valuable functions for many years to come.

The Chamber of Shipping and Port Charges.

The Chamber of Shipping of the United Kingdom in its Annual Report for 1942-3, issued late in February, had some pertinent remarks to make on the subject of port charges in this country. The following extract is of interest to port authorities:

" The Chamber has continued to watch the position as regards dock charges and dues, and through the Traders' Co-ordinating Committee on Dock Charges has, where necessary, made appropriate representations to the Ministry of War Transport. On the whole, the level of port costs has not risen unduly in the period under review, although the decasualisation of dock labour under the Essential Works Orders has resulted in a number of ports in increased charges for services which involve the employment of dock labour. These increases particularly affect the owners of coasting tonnage, and if decasualisation of dock labour is continued after the war, the incidence of these charges and their effect on the competitive position of coastwise shipping as a form of internal transport will need to be carefully considered. The arrangement of last year by which the dock charging powers of statutory dock and harbour undertakings are not allowed to be increased by more than 100 per cent. over the pre-war level remains in operation.

" In reply to representations against the imposition on certain dock and harbour authorities of a burden of debt in the form of interest-free loans, to tide them over war-time financial difficulties, the Ministry has stated that the present policy of giving Treasury assistance by way of interest-free loans cannot be departed from. An assurance has, however, been given that the position of dock authorities assisted in this way will be reviewed at the end of the war."

The Report also discussed the question of pilotage charges and in that connection touched upon the proposal which has been made for the co-ordination on a national basis of the administration of pilotage services through a central organisation. The Chamber is examining the question. It furnishes yet another illustration of the tendency in Government official circles towards concentrating administrative powers in the hands of an oligarchic bureaucracy.

Abandonment of British Canals.

Following the announcement which appeared in our last issue in regard to the disposal of the Monkland Canal at Glasgow, two similar intimations of closure and abandonment have been made about canal undertakings in England and Wales.

The Great Western Railway Company state in their report for the past year that they desire to apply to the Ministry of War Transport for a Warrant authorising them to abandon the small Stover Canal in the West of England and an Order releasing them from their liability for its maintenance and all other obligations in connection therewith.

The Corporation of Cardiff is promoting a Bill in the present session of Parliament to enable them, among other matters, to acquire and eventually close the Glamorganshire Canal, which has been in existence for about a century and a half, its construction having been authorised in 1790. The original canal ran from Merthyr Tydfil, on the northern verge of Glamorganshire to the vicinity of Cardiff, a later extension reaching the sea, with a sea entrance lock, which was opened in June, 1798. A note of its leading features and commercial history will be found on a subsequent page.

While the utility and value of British inland waterways are coming in for a greater degree of recognition and exploitation than heretofore, it has to be admitted that there are certain canals which have outlived their usefulness and are now obsolete, with little prospect of resuscitation within the bounds of economic outlay. In such cases, the wise course is to shut down without further delay. In the case of the Glamorganshire undertaking, the canal in its lower reaches, flows through the heart of the modern city and occupies space which can be more usefully devoted to street improvements and other purposes, though these are hardly likely to be put in hand under present conditions. Moreover, the scope of utility of the canal has declined by reason of the development of road and rail traffic and the northern half of its length has been out of commission for the past twenty years.

Drag Suction Dredging.

The process of dredging as a means of channel maintenance and improvement is so important and even so essential to the welfare and progress of a port, that, following the very informative Paper by Lieut.-Col. Vaughan on Sea-going Hopper Dredgers, published in recent issues, our readers, more especially those who are engaged in the engineering profession, will be sure to welcome the practical notes on Drag Suction Dredging by two expert authorities, which appear in this issue. The *nom-de-plume* of " Helios," we may say, conceals the identity of an English engineer, who has had wide experience in suction dredger design and operation, so that his observations must carry great weight and they will be found of considerable practical value. Señor Repossini is equally competent to speak on the matter from his extensive acquaintance with the treatment of Argentine river channels. The two articles, in fact, constitute a most useful contribution to the current literature on the subject.

Dock Labour Grievances.

We had occasion in our last issue to remark on the persistence of unrest among dock labourers in certain English ports, due to dissatisfaction with the conditions of labour under the new conditions of service. The grievances lie principally in regard to the transfer of workers to other than their own home ports for temporary duty under the mobile port labour scheme. The men have complained that they have not the same comfort and amenities as those to which they are accustomed in their normal surroundings. The lodgings provided for them have been criticised as unsuitable and the meals obtainable as inferior. Steps are now being taken by the Ministry of Labour and the Ministry of War Transport to remedy these grievances and to ensure that lodging accommodation and food arrangements are more to the men's taste, though it is not altogether easy to give satisfaction where there is a predisposition to find fault, as is much to be suspected.

View Showing Piers Nos. 1, 2 and 3. Port of Astoria Terminals.

The Port of Astoria, Oregon, U.S.A.

Port and Harbour Conditions

General Description

THE COLUMBIA RIVER, which constitutes the navigable approach to the Ports of Portland, Astoria, Longview, and Vancouver, rises in British Columbia, flows about 1,200 miles in a general South-westerly direction through the State of Washington and between the States of Washington and Oregon, passing through the Cascade Mountains and entering the Pacific Ocean at 46° 15′ north latitude. The mouth of the river is 645 miles north of San Francisco Bay and 160 miles south of the Strait of Juan de Fuca. The principal tributary of the Columbia River, from a navigation standpoint, is the Willamette River, which flows northward through the State of Oregon between the Cascade and Coast Range Mountains and enters the Columbia about 100 miles from the sea.

The cities of major importance on the navigable channel of the Columbia River are Astoria, Longview, St. Helens and Vancouver, although there are numerous communities of smaller size located on the Columbia below the Willamette, from several of which large quantities of lumber are shipped in deep-draft vessels. Portland is located on both banks of the Willamette River, at the head of deep-water navigation, 14 miles from the confluence of that river and the Columbia and 113 miles distant from the ocean.

Astoria had a population of 10,349 in 1930. It is located on a peninsula on the south bank of the Columbia River, about 10 miles from the ocean, and is bounded on the west and south by Youngs Bay and Youngs River. Its importance as a port for vessels engaged in overseas and domestic commerce increased with the completion of modern deep-water terminals. The fish canneries and lumber flour mills in the vicinity provide a large part of the water-borne traffic. The Spokane, Portland and Seattle Railway, through its joint control by the Great Northern and Northern Pacific systems, provides a transcontinental service for the port.

Across Youngs Bay from the city of Astoria is the town of Warrenton, which has a population of approximately 600. Skipanon Waterway, in which a channel 200-ft. wide and 30-ft. deep has been dredged, connects the town with deep water in Youngs Bay. Two saw mills located on this channel are accessible to lumber carriers in coastwise, foreign and intercoastal trade.

The Columbia River Channel.—The channel at the mouth of the Columbia River is protected and improved by outwardly converging rubble-mound jetties, the outer ends of which are approximately 2 miles apart, and has a minimum width between the 40-ft. contour lines of 8,000-ft. A draft of 35-ft. is practicable at mean lower low water under ordinary conditions.

The channel in the Columbia River from the ocean to the mouth of the Willamette has a width of 500-ft., and a project depth at low water of 35-ft. The annual freshets cause shoaling in some places but the channel depths are restored by dredging.

From the mouth of the Willamette River to Vancouver, the channel in the Columbia is 300-ft. wide and 30-ft. deep at mean low water. The channel has been improved by dykes and is well marked by range lights, etc.

Tides

Owing to the marked difference between the two daily low-water heights on the Pacific Coast of the United States, the mean of the lower low waters rather than the mean of all low waters has been adopted as the plane of reference for this coast.

At the mouth of the Columbia River the mean range of tide is 7.5-ft. and at the entrance of the Willamette River the mean range is 1½-ft. Extreme tidal ranges are about 13-ft. and 3-ft. respectively.

Although the tidal range is small above the confluence of the Columbia and Willamette Rivers, the annual freshets cause large fluctuations in the level of both rivers. The rivers are usually highest in May, June and July, and lowest in September, October and November. The heights above normal during the freshets generally range from zero at Astoria to 20-ft. at Vancouver and Portland.

Tidal Currents

In the entrance of the Columbia River the velocity of the currents is variable. On a flood tide a velocity of 2 knots is seldom exceeded; but the velocity sometimes attains 5 knots during an ebb tide. This variation is due largely to the strength of the river discharge, the velocity of the tide alone being 2.5 knots at strength of either flood or ebb. Above the mouth of the Columbia the velocity of the current averages from 1 to 2 knots, except during the freshet period, when it is considerably increased, although not sufficiently to affect navigation seriously.

Anchorages

There are no prescribed anchorage grounds off Astoria. Anchorage is not permitted in an area one-half a mile wide, extending from the wharf at Fort Stevens, near Point Adams, to the wharf at Fort Columbia, at the foot of Scarboro Hill, on the north side of the Columbia River. Satisfactory anchorage is found just above Astoria and west of Tongue Point on both sides of the main channel.

*Excerpts from Port Series No. 32, prepared by the Board of Engineers for Rivers and Harbours, War Department and United States Maritime Commission, Washington, 1940.

Port of Astoria, Oregon, U.S.A.—continued

Weather Conditions

Open Season for Navigation.—The Columbia River is navigable throughout the year. Navigation by smaller vessels and river boats may be rendered difficult for short periods in the winter when there is ice in the river.

Prevailing Winds.—During the months from April to August, inclusive, the prevailing winds in the vicinity of Astoria are from the north-west; for the remainder of the year south-westerly winds prevail. On the coast, north-west winds of high velocity, sometimes developing into gales which last several days, are not infrequent during the summer months, and during the winter months severe south gales may occur at any time, and a heavy south-west swell prevails.

On the lower Columbia River the average hourly wind velocity for the year is high. Records of the United States Weather Bureau for a period of 26 years indicate the average to be 14 miles, increasing from 10 miles in July and August to 19 miles per hour in December.

Ice.—Ice forms occasionally in the two rivers, but it is seldom heavy enough to seriously affect navigation.

Fogs.—Although fogs are most frequent on the outside coast of Oregon during the months of July, August and September, they may occur at any time. They are at times dense, extend many miles seaward, and frequently, during the months of greatest prevalence, continue for extended periods.

While fogs are more prevalent during the summer months on the outside coast, this condition does not prevail on the Columbia River, as is shown by official records kept for a period of 18 years.

Precipitation.—The North Pacific coast experiences a rainy and a dry season, the former occurring during the months October to May, inclusive, and the latter during the remaining months of the year. The normal amount of precipitation at Astoria is 77.05-in.

Snow does not fall in substantial amounts in the regions drained by the lower Columbia River.

Temperature.—The mean maximum temperature of Astoria for a period of 38 years is 57.8 degrees Fahrenheit, while the mean minimum temperature for the same period is 44.7 degrees. During 1938, the maximum temperature was 89 degrees on July 14th and the minimum 28 degrees on March 29th.

Bridges

The only bridges at Astoria which cross navigable sections of the harbour are the Spokane, Portland and Seattle Railway bridge and the State Highway Bridge which cross Youngs Bay from the southward. The navigable channel in the bay is used only by local shallow draft vessels. The first bridge mentioned is operated solely for railroad purposes. Its draw is of the swing type, having left and right channel openings 130-ft. wide. It has a clear height above mean low water of 18-ft. and above high water of 10.5-ft.

About 2 miles south of the railway bridge is a highway bridge owned by the State of Oregon Highway Commission. This is of double bascule type with a single opening 150-ft. wide. The bridge, then closed, has a clear height above low water of 19.8-ft., and above high water of 6-ft. Regulations prescribed by the Secretary of War on November 23rd, 1929, for the operation of the two bridges described above require that they shall be promptly opened for the passage of steamboats or other craft upon the giving of certain signals.

Channel Improvements by the United States.

At the mouth of the Columbia River there were formerly from one to three channels, these varying from time to time both in location and depth. Channel depths ranged from 19 to 21-ft. at mean lower low water and the outer ends of the channels shifted over the bar between Cape Disappointment and Point Adams over a distance of nearly 6 miles. Previous to 1905 much work had been done on the improvement of the river entrance.

The present Government project for the improvement of the bar was adopted in 1905, and provides for an entrance channel 40-ft. deep at mean lower low water and of suitable width (not less than one-half mile), to be secured by dredging and by the construction of converging rubble-mound jetties, the south jetty to be about 7 miles long, and the north jetty about 2½ miles long, terminating 2 miles north of the end of the south jetty. By 1918 the various features of the project had been completed.

The channel between Portland and Vancouver and the sea was formerly obstructed by numerous sand bars, in which were comparatively narrow channels with depths varying from 10 to 15-ft. at low water. Much work had been done by the Government in overcoming these conditions, both by dredging and the construction of dykes, revetments, etc. The existing project of Government improvement provides for a channel 35-ft. deep and 500-ft. wide in the Columbia River from its mouth to the mouth of the Willamette River to Portland, a distance of 99 miles and thence up the Willamette River to Portland, about 14 miles; a channel 30-ft. deep and 300-ft. wide from the mouth of the Willamette to Vancouver, Washington, a distance of 4½ miles; an auxiliary channel 10-ft. deep and 300-ft. wide in the Columbia River in the vicinity of Cathlamer; a channel 200-ft. wide and 24-ft. deep along the water front at Ranier, Oregon, extended at its upper and lower ends to deep water in the Columbia River; and a channel at St. Helens, Oregon, 30-ft. deep and 300-ft. wide extending to deep water in the Columbia River at its lower end, and 30-ft. deep and 500-ft. wide extending to deep water in the Columbia River at its upper end.

Channel Improvements by Local Interests

Although no local co-operation was required by the Government in connection with the improvement of the entrance channel, such co-operation has been extended by both Portland and Astoria, the former city having contributed $475,000 and the latter $25,000 to the cost of this operation.

The river and harbour act approved March 3rd, 1925, provides that the original cost of dredging the new channel in the Columbia River between the mouth of the Willamette River and Vancouver and the cost of dyke construction shall be borne by local interests. In accordance with this provision the Port of Vancouver has contributed $92,000 and under previous projects $27,500 for channel improvements.

The existing project provides for a 35-ft. depth in the Portland Harbour extending from the mouth of the Willamatte River to the Broadway Ridge, excluding the areas within 50-ft. of the pier head lines, subject to the provision that the port of Portland shall, when requested by the district engineer, assist in the work of improving and maintaining the depth in the Portland Harbour and the channel in the Columbia River by loaning to the United States hydraulic pipe-line dredges.

Terminal Improvements

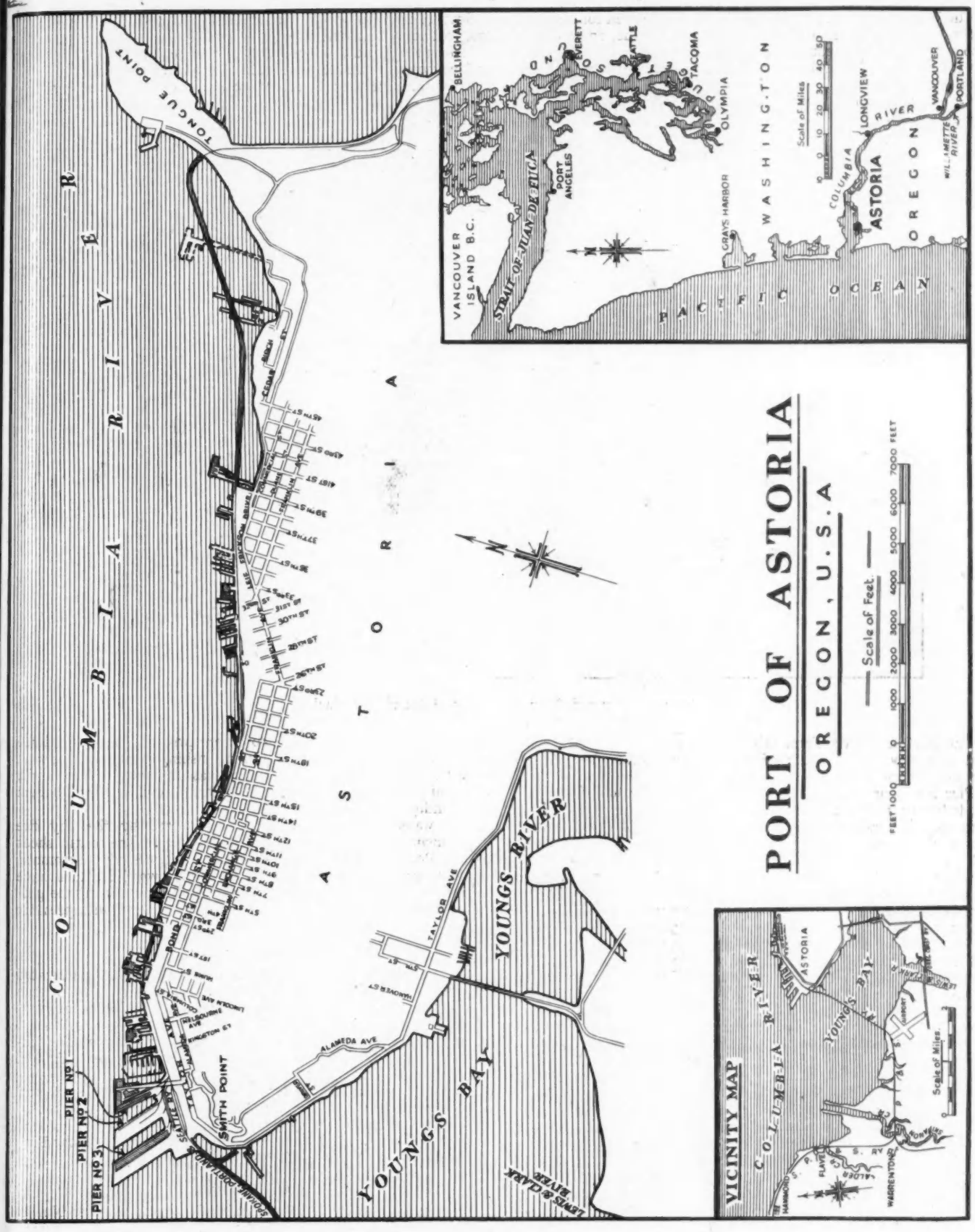
The improvement of the channel both at the entrance to and in the Columbia River has been followed by extensive terminal improvements designed adequately to handle foreign, intercoastal and coastwise commerce. Piers and wharves of great capacity and of modern design, supplemented by a large grain elevator and flour mill, have been constructed at Astoria. The development of the lumber industry in the Columbia River Basin has been greatly stimulated by the ability of deep-draft vessels to reach the mills, and lumber concerns throughout this area have enlarged their plants and wharves to meet the demands of the lumber trade.

Ownership of Water Front

The Port of Astoria, a municipal corporation embracing all of Clatsop County, owns 8,840-ft. of the water front at Smith Point. Of this frontage, approximately 2,300-ft. have been developed by the construction of the Port of Astoria terminals. The remaining water front is owned by the City of Astoria, the County of Clatsop, and private individuals or corporations, including the Spokane, Portland and Seattle Railway.

Port and Harbour Facilities

Practically all of the facilities utilised for handling waterborne commerce at the Port of Astoria are located on the left bank of the Columbia River. The principal piers extend to the main ship channel, which allows vessels to berth or sail at any time without the aid of tow boats.



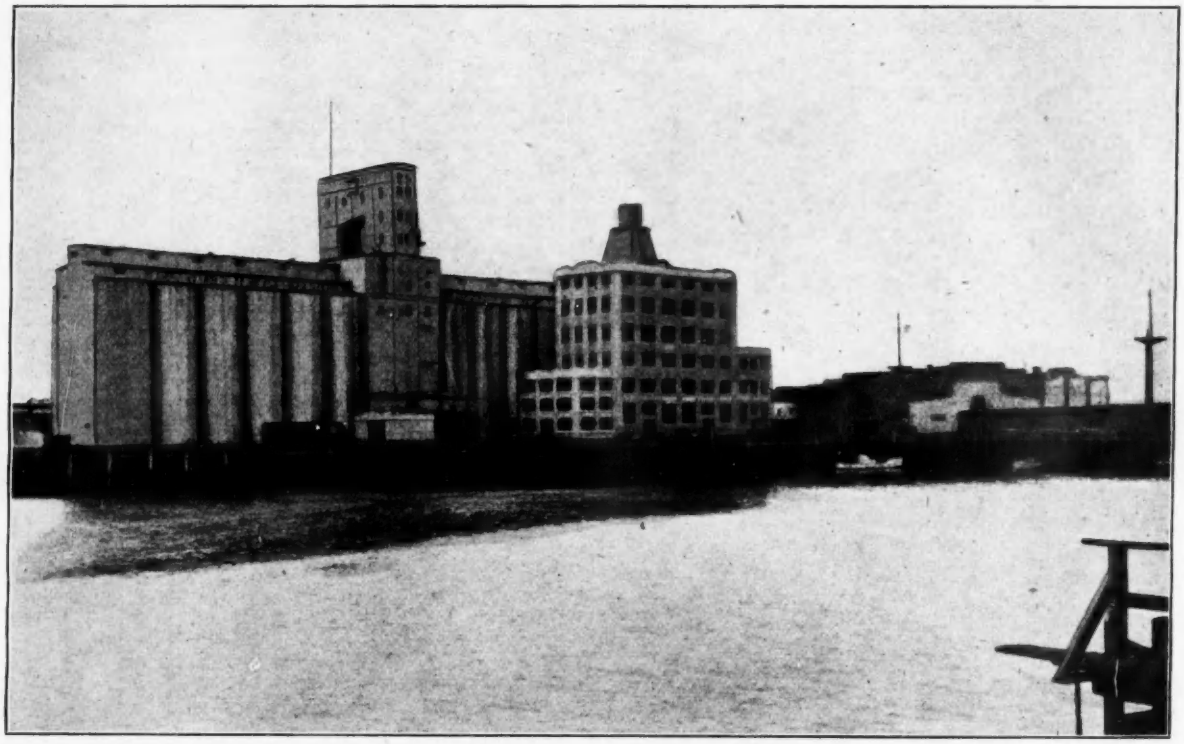
Plan of the Port of Astoria, Oregon, U.S.A.

Port of Astoria, Oregon, U.S.A.—continued

There are 41 piers and wharves, 6 of which are used for handling general cargo in foreign and domestic or inland trade, one of which also is used for oil bunkering, 18 for the receipt of fresh fish, 4 for the receipt of petroleum products and for bunkering, 2 are used by marine repair plants, 2 are owned and operated by the United States Government, and the remainder are used for miscellaneous purposes.

Switching service at the Port of Astoria terminal is performed by the Port of Astoria belt line.

Fish packing and canning is one of Astoria's important industries and numerous wharves have been constructed and modern sanitary facilities installed to receive, can, pack, ship and store fish. The larger wharves are served by the Spokane, Portland and Seattle Railway.



Grain Elevator and Flour Mill. Port of Astoria Terminals.

The Port of Astoria Terminals, which consist of Piers No. 1, 2 and 3, are located at Smith's Point and are owned and operated by the Port of Astoria.

Pier No. 1 provides 1,723-ft. of berthing space and the transit sheds have a total of 186,300 sq. ft. of floor space. A reinforced concrete bulk grain elevator with a capacity of 1,250,000 bushels has a single-belt conveyor gallery which extends to the lower side of the pier. It also has modern equipment for handling bulk and sacked grain to vessels and from cars. A flour mill located adjacent to the elevator has a grinding capacity of 4,000 barrels per day. The transit sheds are served by a herring-bone system of tracks with 11 depressed spurs. The grain elevator and flour mill are served by five surface tracks.

Pier No. 2 is an open pier used principally for the handling and storage of lumber and bulk commodities. This pier is of open-pile timber-deck construction with solid-fill centre. It has a berthing capacity of 3,178-ft. and a depth of 35-ft. of water alongside at mean lower low water. Two surface tracks located on the upper side and 2 in the centre of the pier connect with the main line of the Spokane, Portland and Seattle Railway. A gridiron 48-ft. by 150-ft. is located at the bulkhead between Piers Nos. 1 and 2, which is used for handling heavy equipment in inter-change between land and water.

Pier No. 3, the largest of the port facilities, is utilised for handling general cargo in foreign and domestic trade. This pier provides 2,121-ft. of berthing space at the face and upper side. The transit shed, which has 248,000 sq. ft. of floor space, is also used as a storage warehouse. One 1,800-ft. depressed track, located in the rear of the transit shed, connects with the Spokane, Portland and Seattle Railway.

The other wharves in the harbour are privately owned and are used for oil bunkering, for berthing fishing boats, as bases of operations for tow boat companies, as outfitting wharves for companies engaged in marine repair work, or in connection with other industrial plants.

The water front at the port is protected by the city fire department, which consists of three companies. The transit sheds at the Port of Astoria terminals are equipped with automatic sprinkler systems and most of the privately-owned facilities have special fire-fighting apparatus. There are no fire boats at the port but many of the commercial tow boats are equipped with pressure pumps and will assist in cases of emergency.

Hoisting Facilities

The principal shipside hoisting facilities at the port are located on Pier No. 2, Port of Astoria terminals, and consist of two steam locomotive cranes, one of which has a lifting capacity of 35 tons, with a 55-ft. boom; the other can handle single lifts up to 50 tons and is fitted with an 85-ft. boom. On all of the fish-receiving wharves there are small electric and hand-operated fixed hoists.

The only hoisting equipment afloat at the port is owned and operated by the Brookfield Co., which is located at the foot of Thirty-second Street. This company has two towed barges, each of which is equipped with stiff-leg derricks capable of handling single lifts up to 10 tons with 75-ft. booms.

Grain Elevators

One public transfer elevator, which is located on Pier No. 1, Port of Astoria terminals, serves the port. This elevator is owned

Port of Astoria, Oregon, U.S.A.—continued

and operated by the Port of Astoria. It is of reinforced concrete fireproof construction and has a storage capacity of 1,250,000 bushels. The lower side of the wharf serving the elevator has a berthing space of 1,103-ft. and a depth of water alongside of 36-ft. Bulk grain can be loaded into vessels at the rate of 16,000 bushels per hour by means of a single-belt grain gallery, equipped with one loading spout, which extends to the lower side of the pier. An average of five cars of bulk grain can be handled per hour by four car pits and power shovel. There is no equipment for handling bulk grain from elevator to cars or from vessels to elevator.

Modern electrically-operated equipment includes cleaners, a drier, smutter and washers, and facilities for handling sacked grain. Five spur tracks serve the elevator. The Spokane, Portland and Seattle Railway and the Port of Astoria belt line provide rail connections and switching service.

Adjacent to this elevator is an export flour mill, with a capacity of 4,000 barrels per day.

Storage Warehouses

The nature of the water-borne commerce of the port is such as to create little demand for storage warehouse space. Shipments of practically all commodities, with the exception of feed, flour, and fish move rapidly as a rule, hence no extensive system of warehouse storage is required.

Covered storage space is available in the transit sheds on Piers Nos. 1 and 3, Port of Astoria terminals, for storage of canned fish and general merchandise. Cargo cranes, portable electric conveyors and gravity chutes are used for the transfer of cargo between storage and vessel.

Cold storage facilities for fresh fish are vailable at the Northwestern Ice and Cold Storage Co., located at the foot of Columbia Street. This plant operates an ammonia-freezing system and has 130,000 cubic ft. of cold storage space. Fresh fish are received direct from vessels.

Additional private dry and cold storage plants for handling canned and fresh fish are located in various sections of the port and are owned and utilised by the fish canneries for storage of their products.

Bulk Freight Storage

Open areas for storage of bulk commodities are available at Piers Nos. 2 and 3, Port of Astoria terminals. At Pier No. 2 lumber is stored in the open while awaiting shipment.

Dry Docks and Marine Railways

There are no dry docks at the port. The Columbia Boat Building Co., 600, Taylor Avenue, operates a marine railway which is located on Youngs Bay between the railroad and highway bridges. This railway can accommodate vessels up to 71-ft. in length. A small railway is operated by the Union Fishermen's Co-operative Packing Co. for private use. This facility is limited to vessels 45-ft. in length.

Marine Repair Plants

There are four marine repair plants and machine shops which serve the large fishing fleets and tow boats. These facilities are equipped to complete repair work on large vessels above the water line, or when dry docking is not necessary.

The Astoria Foundry, Inc., located at Eighteenth and Franklin Avenue, handles foundry work and is equipped to produce iron castings up to 10 tons and brass castings up to 1 ton.

Tacoma Narrows Bridge

The Failure of a Harbour Channel Suspension Bridge

By courtesy of the chairman of the committee appointed by the American Society of Civil Engineers to enquire into the circumstances of the failure of the Tacoma Narrows Bridge adjacent to the Port of Tacoma, Washington, U.S.A.,we have received a copy of the committee's report, made in July last. A few appropriate extracts are given below:

The committee consisted of Professor Chas. M. Spofford (chairman), with Professor Frederick B. Farquharson, Messrs. Jas. H. Cissel, Frank M. Masters and Homer R. Seely.

The bridge was constructed in 1938-40 across Puget Sound, near the city and port of Tacoma. The width of the Sound at its narrowest point is 4,600-ft. and the waterway is of great depth with swift tidal currents. The bridge was intended to replace the ferries which previously had been the only means of direct communication in the vicinity between the mainland and the Olympia Peninsula.

It was a suspension bridge with a centre span of 2,800-ft. and two side spans of 1,100-ft. each. It had a roadway 26-ft. wide and two side walks, 4-ft. 9-in. wide, with a total width of 39-ft. from centre to centre of stiffening girders. There were also plate girder approach spans, which, with the anchorages, made the overall length 5,939-ft.

Regarding the general design, the report points out that the bridge was very narrow as compared with other bridges of even approximately its span, hence the torsional resistance to unsymmetrical loads or gusts was unusually small. This lack was compensated for to some extent by the smaller sag and increased cable loading with resultant increase in cable stiffness.

Failure took place on November 7th, 1940, when the wind reached a recorded velocity of 42 miles per hour. At approximately 10 a.m. on that day, the centre span developed a violent torsional movement with a node at mid-span, the angle of rotation at the quarter point being at times nearly 45 degs. and the amplitude of the vertical motion of the girder approximately 28-ft. The centre span finally failed, portions of the suspended structure dropping into the stream, and, as a result, the side spans sagged and the towers were bent shoreward a maximum deflection of about 24-ft.

The committee's conclusions are as follows:

The failure of the bridge shows that the methods of design computations, which had proved satisfactory on structures of other proportions, were not satisfactory for designing a structure of the proportions used in the Tacoma Narrows Bridge. The three reports on the bridge failure (which are reviewed by the committee and published in appendices) show that the methods used in attempting to reduce the oscillations, which were found to occur after the completion of the bridge, were not effective, although they perhaps delayed the destruction of the bridge. The committee express the hope that further research will be successful in advancing the science of designing long span suspension bridges so that they will safely resist both static and dynamic forces.

Proposed Closure of Danish Waterway.

A proposal has been laid before the Danish Rigsdag to close the Thyboroen Channel, the Western approach to the Limfjord on the ground of the heavy expenditure involved in protecting the low-lying land near the fjord and of dealing with the silt accumulation in the channel. The local inhabitants, especially fishermen and their families, numbering some 1,200 people, are strongly opposed to the proposal since it would affect their means of subsistence, while fishermen in other villages on the Western Limfjord anticipate that the fish supply would suffer if the inflow of water from the North Sea were stopped.

A Bill authorising the closing of the channel has been introduced into the Folketing by the Danish Minister of Public Works. It proposes that a dam about 20 kilometres long and 5 metres high should be constructed at Government expense behind the existing sea wall, in order to protect the land near the Limfjord. The total cost is estimated at 16 million kroner. Provision is also made for transferring elsewhere the inhabitants of Thyboroen who will lose their livelihood. Hanstholm has been suggested as an alternative fishing centre. It is estimated that the construction of a fishing harbour there would take six to eight years, the same time as is estimated for the construction of the dam.

Notes of the Month

Welsh Harbour Appointment.

Mr. E. J. Davies, of Lagos, Longstone, Mon., has been appointed Harbour Superintendent at Llanelly in succession to the late Mr. J. Winterbottom.

Extension of Mombasa Harbour.

At the East African Port of Mombasa, two deep water berths are being added to the existing berthage at a cost of half-a-million. They will have the effect of increasing the berthage accommodation of the port by one-third.

Refloating Singapore Dock.

The Japanese have announced their intention shortly to raise and refloat the Floating Dock at Singapore, which was sunk by the British force before the fall of the naval base there in 1941. The dock is 855-ft. long and 178-ft. wide and has a lifting capacity of 50,000 tons.

British West India Port Improvements.

In a report recently issued in reference to the Colonal Development Act, 1940, it is stated that provision is to be made for the installation of a modern optical apparatus in the lighthouse at Grand Turk Island in the Bahamas, and that expert advice is to be obtained on the re-organisation and extension of the Port of Kingston, Jamaica.

Peruvian Port Development.

In accordance with earlier announcements that the work was in contemplation, active steps have now been taken to develop the harbour of Chimbote in Peru, stated to be one of the finest natural harbours along the South American Coast. It will be used for the export of iron, steel and coal from the adjacent rich mineral region. The provisional plan includes the construction of a pier, power house and labour camp.

New Mexican Graving Dock.

The Mexican Government is reported to have granted a concession to a recently organised dry dock and shipyard construction company in Mexico, for the construction on the right bank of the Panuco River of a graving dock large enough for vessels up to 15,000 tons. The concession is for a period of 20 years, at the expiry of which the Government will assume control of the business. The dock, it is stipulated, must be completed within 2 years from time of starting. The estimated cost is 4 million pesos.

Merseyside Dock Access Committee.

Sir Robert Rankin, member for the Kirkdale Division of Liverpool, recently raised in the House of Commons a question as to why the Mersey Dock Access Committee did not include "a Liverpool steamship owner or director of a Liverpool steamship company. The Minister of War Transport, through the Parliamentary Secretary, replied that he did not consider it necessary to include a representative of the shipping industry and that the work to be done could be most effectively accomplished by a small expert body of the kind he had appointed.

Dock Labour Scheme at the Port of Ipswich.

A dock labour scheme, under the Essential Work (Dock Labour) Order, 1941, has been put into operation at the Port of Ipswich. The port area covered by the scheme consists of all the area within an imaginary line drawn from Shotley Spit Buoy and Fagborough Cliff to Stoke Bridge. The scheme, which became operative on March 8th, follows the lines of the schemes in operation at other ports in the United Kingdom. The Ipswich Dock Labour Board, with offices at Prudential Buildings, Princes Street, Ipswich, comprises Mr. E. C. Tetsall (chairman), Mr. J. Barker, Mr. M. Bedford, Mr. J. M. Coates and Mr. A. V. Smith. The local manager is Mr. S. H. Alexander.

Port of Copenhagen Finances.

The income of the Port of Copenhagen rose from 3,800,000 kroner in 1940-1, to 4,000,000 kroner in 1941-2, but owing to higher outgoings the deficit increased to 800,000 kroner.

Devastation at Port of Genoa.

According to Rome reports received by the German controlled Scandinavian Telegraph Bureau, all quays, transport facilities and warehouses at the Port of Genoa have been demolished in the attacks of the Royal Air Force during recent raids.

Enlargement of U.S. Intracoastal Waterway.

The Corps of Engineers of the United States Army have commenced dredging operations in connection with the enlargement of the intracoastal waterway from the vicinity of Rigelets, La., to Carrabelle, Fla. The quantity to be dredged is about 19 million cu. yds. and the estimated cost $2,795,000.

Port of Kolding Report.

The report of the Kolding (Denmark) Port Authority for the year 1941-42 states that 1,367 vessels, of 199,488 tons net, arrived at the port during the year, including 814 steamers and motor ships, of 168,664 tons. Inward cargo totalled about 96,700 tons and outward cargo about 116,700 tons. The accounts show receipts totally 534,950 kroner, and a surplus of 51,461 kroner.

Death of Former Clyde Navigation Representative.

Lieut.-Commander Sir August B. T. Cayzer, R.N. (retd.), who died on 28th February, was a representative on the Clyde Navigation Trust from 1907 to 1917. As chairman of Cayzer, Irvine and Co., Ltd., and Clan Line Steamers, Ltd., he had close associations with the Port of Glasgow. He was also a member of the Board of the Suez Canal Company.

Tragic Incident at Liverpool Docks.

One night at the end of February, a docker employed at the Liverpool Docks was shot dead in a quayside warehouse, in consequence of which the day shift of workers temporarily refused to go on duty at the point. At the subsequent inquest, it was stated by the Coroner that he had received a communication from the Provost Marshal of the U.S.A. forces informing him that a certain member of the U.S. Army had been detained and charged with the death of the deceased. The inquest was, accordingly, adjourned *sine die*.

Proposed New "Port" at Geneva.

According to the *Bulletin Technique de la Suisse Romande* a new navigable waterway connecting the River Rhone with a new "port" or harbour basin on the shores of Lake Leman is projected at Geneva. The waterway will traverse the city from the basin which is to be constructed at Reposoir in the environs of the city. The traffic capacity of the basin and waterway is put at 3 to 4 million tons per annum and the total cost of the undertaking is estimated at 53 million (Swiss) francs.

Courageous Conduct of a Port Employee.

The Silver Medal and Certificate of thanks from the Liverpool Shipwreck and Humane Society has been presented to Mr. Archibald Hardie, a crane-driver in the Engineer's Department of the Mersey Docks and Harbour Board. Hardie saved two men when a truck, containing 8 passengers and a driver, skidded, slipped over the side of the quay and fell to the bottom of a dock. It was dark at the time, and though all the nine men extricated themselves and reached the surface, Hardie had to dive into the dock to rescue two of them who became exhausted. In making the presentation, Mr. R. J. Hodges, general manager of the Dock Board, said it was one of the finest dock rescues in his recollection. Hardie has already been the recipient of the B.E.M. (Civil Division).

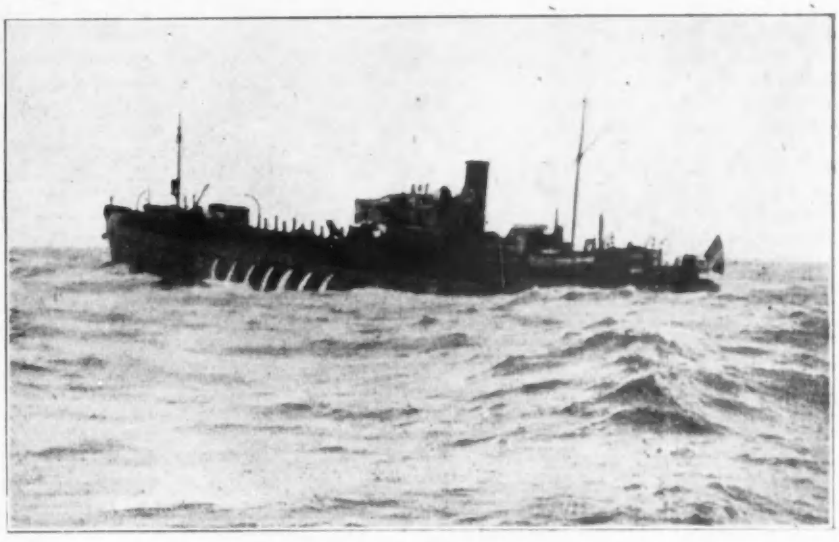
Notes on Drag-Suction Dredging

By "HELIOS."

THERE has been a marked tendency during the last two decades for the drag suction type of dredger to take the place of the moored suction dredger. This is very natural since the drag type can be used as a moored ship, if necessary, and when operating in its own proper way has a higher output than the moored type. The latter makes holes and must use a rotary cutter for all but quite loose material. The drag type can handle mud and silt with great success and deals with sand, small gravel and mixed alluvium with moderate ease, the proportion of water taken in increasing with the coarseness of the material.

The following interesting problems arise in connection with the design of a drag suction dredger:

(1) Position of the drag head.
(2) Construction of the suction pipe.
(3) Construction of the drag head.
(4) Distribution of power.
(5) Applications of the internal combustion engine.
(6) Hopper arrangements.

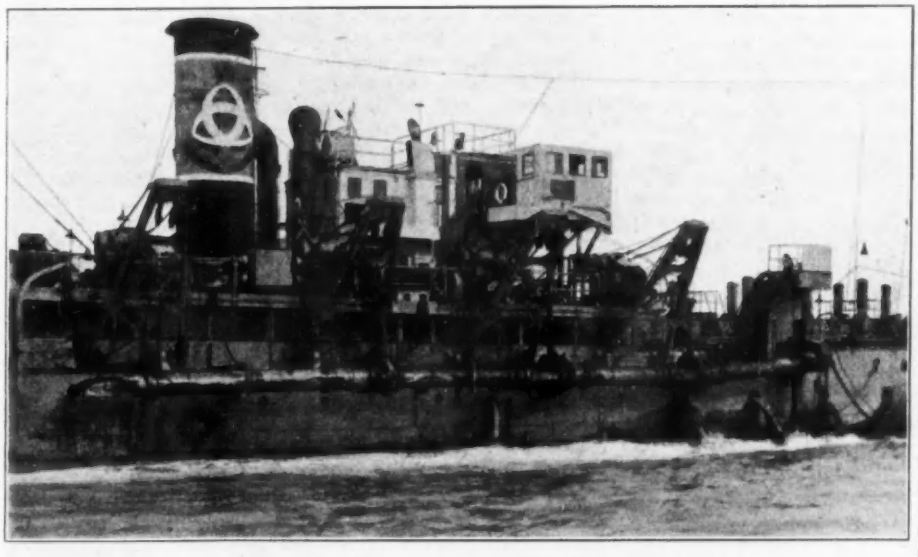


Dredger, *Pierre Lefort*, working in a swell.

(1) Position of Drag Head

The original Fruehling dredger had a stern slot and the drag head touched the sea bed almost under the rudders. The objection to this is that steerage control, except in still water or following current is very poor. Assistance with jets or transverse propellers in the bow of the ship is necessary if there is any cross current. The later Argentine dredgers, most of the U.S. Corps of Engineers' dredgers, the two Shanghai vessels and one of the Basra ones, have centre wells which permit the drag head to touch the bottom under the centre of the ship. This gives the best pipe arrangement and very fair steering control. Most of the Basra dredgers have bow wells which allow the drag head to touch the bottom well ahead of the centre of the ship. This gives the maximum steering control, but involves a very long suction pipe with a very bad reverse bend. The latter seriously reduces the effective suction head, of which there is little or no margin.

The French type (Pierre Lefort and Victor Guilloux) have two semi-flexible outboard trailing pipes slung alongside. The heads touch the bottom abaft the centre, but the pipe lines not being rigid there is little interference with steerage.



Dredger, *Pierre Lefort*, Suction Tube and Lifting Gear.

(2) Construction of Suction Pipe

To get a rich mixture the suction pipe should be large (not much less than 3-ft. diameter is desirable), short, straight, single, and as direct as possible from the sea bed to the eye of the pump. The latter should be as low as possible in the ship. The 25-ft. or so of effective suction head which is produced by the vacuum has to overcome friction in the suction pipe, has to support the excess weight of the rising column of mixture over that of water, has to provide the kinetic energy of the mixture and has to keep the solids in a state of suspension in the mixture. Furthermore, it has often to overcome the loss of energy in the curve of the drag head and in many vessels it is also called upon to drive the mixture up syphons, through forked trunnions and round bends leading to pumps. In the cases where this is done a thick mixture is almost impossible to obtain except with soft light materials and shallow depths.

When the pipe is in a slot, it must be rigid and this is usually achieved by carrying it in a ladder frame which runs in guides on the walls of the slot. Transverse currents cause large forces to be applied to the ladder and so to the hull, which must be strengthened accordingly.

(3) Construction of Drag Head

The drag head has not yet reached final form, but there are two major types:—

(a) The **scoop type,** which faces forward and in its well-developed form is stream lined on the inside.

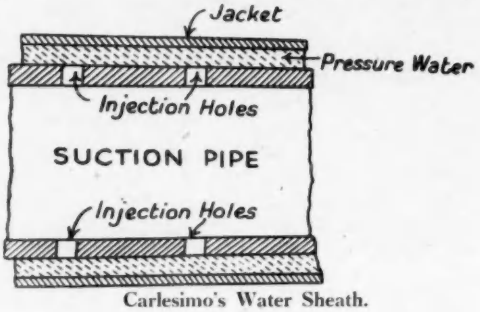
(b) The **shoe type** with the opening underneath, the cutting of the bed being done by grid bars which also serve as a strum.

The unclosed mouth area must be as small as possible so that when dredging soft material the head may be wholly buried and when dredging sand or fine gravel, the opening should be sufficient to admit only that minimum quantity of water required to render the material mobile.

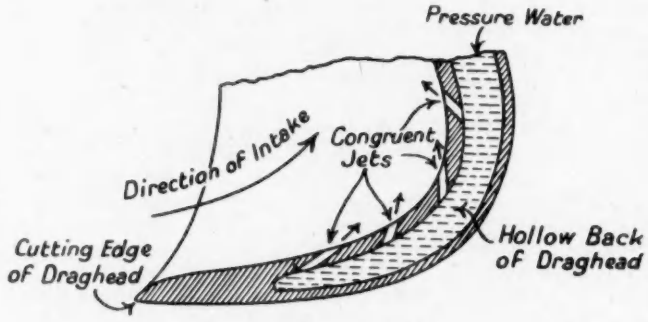
Notes on Drag-Suction Dredging—continued

Carlesimo's bold scheme, used in the "M.P.P 212 C" at Buenos Aires, of a forward facing suction with an open mouth has not been repeated, doubtless owing to the fact that most jobs have some sand as well as mud and the hazards of over-riding the pipe appear formidable in spite of the most ingenious devices he developed to prevent such a calamity.

There is much difference of opinion as to injection water for reducing pipe friction. Carlesimo's sheath system and Chatley's congruent jets both appear to be successful, but there has been a common tendency to regard the jets as of value to break up the sea bed. Since a water jet must have very high velocity and immediate contact with the material to be broken up, if its effects are not to be killed by water cushion, great care is required in the placing of the jets. Furthermore, the flow must not be against the general pumping direction and the pipes must not obstruct the passages.



Carlesimo's Water Sheath.



Chatley's Congruent Jets.

(4) Distribution of Power

The general practice is to put about two-thirds of the power (Repossini advocates four-sevenths) into the propelling engines. The dredging speed is generally less than one quarter the cruising speed so that hull resistance might be expected to be only about one-sixteenth that when cruising, but when dredging, owing to the proximity of the sea bed, the disturbance of the water and instability of the conditions, the resistance is probably higher than this, so that there is a good case for ample propelling power to provide the cutting force. This is especially true when dredging sand or fine gravel which will require several times the thrust necessary for mud of the same depth. The pumping power must also be liberal, say, one quarter to one half a horse-power per cubic yard of mud and at least twice as much for fine sand and four times as much for coarse sand. Taking the propelling power as twice the pumping power, this gives a total of three-quarters of a horse-power per yard situ of mud per hour as a minimum up to, perhaps, 6 h.p. for coarse material. These figures are for large plants.

(5) Application of the Internal Combustion Engine

In America, both at Buenos Aires and also in the United States, success has been achieved with Diesel drives, either direct or with electric conversion. The latter seems very advantageous in view of the large number of auxiliary machines. The adoption of oil engines is largely a matter of the cost and accessibility of oil and the existence of skilled operators. In a drag suction dredger the saving of space for boilers is not quite so important as in a merchantman, as the hopper compels the use of large buoyancy spaces anyhow.

The elasticity and simplicity of the steam engine are favourable features in a machine which has a fluctuating lead and the use of mechanical stokers enables dust coal to be used, but there can be no doubt that where oil is cheap, there is much to be said for the internal combustion engine being used.

(6) Hopper Arrangements

The hoppers should be as large as manœuvrability and draught will permit in order that there shall be the maximum proportion of dredging time. The greatest possible efforts should be made to get a thick mixture, even if it involves a reduced pumping rate since, unless the material is really coarse, it will not settle in the hoppers. Baffle plates have practically no effect in settling fine suspensions In many places doorless hoppers are used to avoid leakage, the pumps being always used to empty the hoppers. Lyster cylindrical hopper valves have also been used with success.

As an appropriate appendix to the foregoing article, a translation is given below of the views of a distinguished Argentine Engineer, communicated to International Navigation Congress at Cairo in 1926.

Intensive Suction Dredging

By J. R. REPOSSINI, Inspector General of Navigation and River Ports. Buenos Aires.

General Conclusions from **"Dragados intensivos à succion,"** communicated to the XIVth International Navigation Congress at Cairo, 1926. Published in Spanish by the Ministry of Public Works of the Argentine Republic, at Buenos Aires, 75 pp. with 35 figures, 8 plates and 4 sheets of tables and diagrams.

A seagoing suction dredger to work in the open sea or in access canals to ports, etc., and able to operate in the various classes of material in the scale clay-loam-sand and their intermediate forms, providing they are susceptible to suction, whether by dry suction (smooth clay), wet suction (sand) or with the use of a mechanical disintegrator or cutter (loams or compact clays), ought to answer, in order to have the widest possible use, to the following general conditions:—

(1) **The hull** should be closed and of the marine type, with characteristics proportioned to the displacement of the vessel with a full load of fuel, water and spoil of the maximum density. The latter is for clay-sand from 1.4 to 1.7 tons per cubic metre. Those ratios of length to volume and volume to draught should be observed which offer the least resistance to propulsion when cruising, and easy control and good dirigibility whilst dredging. The structure should be designed in relation to the hopper and most especially in a longitudinal direction so as to avoid vibrations during unloading. The surface of the rudder should be ample having regard to the precision required during working. The hull should be divided into a number of watertight compartments, so that stability is ensured even if any two compartments are holed. Special regard should be given to the security of the joint where the suction pipe enters the hull and to absence of projecting parts which would cause additional resistance during navigation.

(2) **The suction pipe** should be single, in a central well, and conveniently slung in a mobile ladder. It should be arranged to work by drag suction with a bent spoon head, two forms being provided for working in smooth clays and loose sands respectively. The effective areas of these two heads should be in the ratio of 4 to 1. A mechanical disintegrator, or cutter, should also be provided, fitted to the pipe ladder, for dredging compact clays and loams with the vessel anchored and using head and side lines. The junction of the pipe to the hull, below the light flotation line, ought not to be rigid, but, on the contrary, as elastic as possible, but not with bellow joints. All conditions should be fulfilled

Notes on Drag-Suction Dredging—continued

which assure dirigibility, good control of navigation while working, and certainty of action even in hard material, or on irregular sea beds, or in seas with relatively large swell.

(3) **Location of Pipe Joint.**—The dredger should be able to work with the smallest length of suction pipe at the depth maintenance of which is required, allowing for the greatest rise of tide during high stage, the pipe then being inclined to an angle not greater than 45 degrees. This involves placing the joint to the hull below the flotation line as low as possible, the ladder and its guides moving correspondingly and being designed to minimise torsional forces, etc. With regard to the dredging equipment, taking heed of the need for maximum simplicity in the arrangement of the pipework and valves and the avoidance of small access doors to the internal suction tunnels, this should be able to:—

(a) Suck from the bottom of the sea or river and fill into the ship's hopper, so as to discharge at special dumping places.

(b) Suck from the bottom of the sea or river and force the material through floating pipe lines to the bank of the canal or to the shore; in the last case, with adaptation, if necessary, of a transition pontoon and intermediate pipes.

(4) The **spoil hopper** should have a capacity proportioned to the " optimum output " anticipated, having regard to the nature of the material, in the most varied conditions of the work (on the scale clays to sands), the lifting power of the pumps, the velocity of transportation, the manœuvring conditions of the vessel during dredging and navigation, i.e., all the elements which define the " most convenient cycle " for the " most economic " operation.

The hopper should be placed forward in the vessel, taking into account the convenient distribution of the engines and dredging machinery, control and observation of the mechanism. It should have ample height so as to reduce the length of the pipes which feed the hopper. It should be continuous and the effects upon it of the use of part of the central space for the suction pipe well should be as small as possible. The interior walls of the hopper should be smooth and without projections which would hinder the descent of the spoil and as nearly vertical as possible. Roofed in spaces should have convenient outlets to the lower parts, so as to avoid the trapping of excess water. There should be coamings along the length of the ship to avoid losses by spilling. The lander pipes should be multiple, preferably two on each side, in order conveniently to reduce the discharge of velocity. The discharge sluices should be controllable from open bridges constructed above the highest spoil level in the hopper. The bottom doors should provide the maximum discharge areas, and should be paired on each side in correspondence with each section of the hopper. They should be flat and well strengthened and preferably be inclined towards the keelson so as to facilitate the discharge of the spoil transversely. Their hermetic seal should be obtained by rubber packings or strips of suitable wood. The suspension chains for the doors and the lifting tackle should be of ample strength and they should be able to be operated in conjunction or separately by means of a hydraulic ram which acts over each one independently in starboard and port series, the water pressure not exceeding 40 atmospheres. A double set of hydraulic pumps should be provided, one being kept in reserve. Discharge from the doors should be helped by low pressure water provided by an independent centrifugal pump.

Cylindrical discharge valves, which have a limited application, involve amongst others the following inconveniences:—

(a) They cannot serve for the discharge of materials which offer much adhesion or compactness.

(b) Their obstruction is very easy and possible by extraneous bodies which come between the valve faces and the guides which are provided to ensure the close fit required for the hermetic seal.

(c) For equal carrying capacity, the hopper needs to have a larger volume.

(d) In dredgers which must pump out their own hopper loads, the location of the draw-off tunnels and small valves is complex.

(e) The discharge, like that from a grain silo, in the various sections of the hopper, is effected with difficulty and it is necessary to instal heavy injection pumps which increase costs.

(5) For **propulsion** one should use engines independent of those for dredging, they alone being capable of providing the required cruising velocity without coupling up to the dredging engines; the latter operation always involves delay. This will permit a better distribution of the various parts, the dredging engines being placed immediately in front of the hopper and the propelling machinery in the stern. The propelling engines should be twin screw, so as to facilitate the control of the vessel in narrow water and its general manœuvres when weighing anchor and turning back to the dumping places. The propeller shafts should be stronger than is usual in marine practice, and the flarings should be prolonged to the base of the hull. *(Bocinas prolongadas hasta los pies de gallo).*

The **dredging pumps** should be two in number to avoid as far as possible a complete interruption of the work in the case of accident to one of them. They should be driven by independent engines, capable of amply providing the specified output, with a speed of not more than 150 revs. per minute and a peripheral velocity of 16 to 18 metres per second. The body of each pump should be of cast steel with wearing plates and doors conveniently placed for inspection after isolating doors have previously been closed. The impeller with a steel boss and three or four blades should provide ample tangential clearance so as to avoid accident in case a foreign body enters the pump. For the same reason the arms should not be continued through the whole length of the blades and the latter should be replaceable.

With regard to the hopper, the pumping system should be such that the lander pipes offer the smallest number of curves and returns. The pipes and valves should be conveniently arranged, not only for working in the various ways specified, but also so that the pumps can work singly or in series for reclamation work at a great distance.

(6) The **motive power** ought to be produced from one central steam or Diesel electric plant.

In the first case, it is preferable to keep the boilers and the propelling engines together, and the furnaces should be adapted for burning liquid fuel.

The dredging pumping engines forward will be fed by superheated steam in order to reduce to a minimum the loss of pressure. The boilers should provide ample heating surface, not less than 0.4 square metres per I.H.P.

The capacity of the fuel and fresh water tanks should be such as to assure operation of the vessel for trips of not less than a month. The least capacity should be 500 tons for the kind of vessel under consideration. Their distribution should be very carefully considered, so that the draughts fore and aft will diminish equally during consumption. It should not be forgotten that delays due to refuelling are of a permanent character and the adoption of a special fuel or the installation of a special motive power, which represents less consumption or a larger radius of action for a given capacity, will always be preferable.

Thus, the steam plant would advantageously be replaced, in our opinion, by a central Diesel electric generating set, with capable units, without air pump, low pressure type, capable of producing when suitably combined, the current necessary for the two typical phases of the work:—

(a) Dredging underweigh
(b) Navigation
} relation of power, 1 to $\frac{3}{4}$.

Independent electric motors will drive the propellers, centrifugal pumps, manœuvring winches, etc.

For immediacy of application, elasticity in service, security of function, possibility of exerting most easily central control and command, response day by day in the greatest degree to technical exigencies, and utilisation of the whole equipment, this system has great advantages.

(7) Finally, the vessel must be provided with all **auxiliary machinery,** complementary plants and necessary reserves for normal and continuous functioning so far as may be possible, in order to maintain, without any overloading, the specified output. Thus it is recommended that there should be ample power in the propelling and dredging engines, ample heating surface in the boilers of a steam plant, practical and powerful hydraulic plant

(concluded on page 290)

Legal Notes

Duration of Towage Service

A case was recently decided in the Admiralty Division concerning the question of the precise period of a tug's "attendance" on a vessel. The vessel was the steamship *Elmaale*, belonging to the Morrison Steamship Company, of Newcastle, who claimed damages from the London Midland and Scottish Railway Company, as owners of the tug *Ramsden*, for a collision which occurred in the course of docking the vessel in the Barrow Dock on 22nd December, 1941.

The circumstances were detailed in the following judgment by Lord Justice Bucknill, as reported in *Lloyd's List*.

Mr. Justice Bucknill said the *Elmdale* was 4,872 tons gross and 440-ft. long, and her collison took place just outside the dock entrance of the Barrow Dock. The plaintiffs had ordered two tugs from the harbour authority, who were the agents of the railway company, to take the *Elmdale* into dock. One of the tugs proceeded down the side of the *Elmdale* to make fast astern, but the *Ramsden*, when abreast of the steamer on the starboard side, put her wheel to starboard and thereafter struck the *Elmdale* a right-angle blow just aft of No. 1 hold. Mr. Brightman, for the defendants, relied on two points. The form of towing contract laid down that "on the hiring of tugs" the master and crew of the tug became the servants ot and identified themselves with the vessel and were under the control of the persons in charge of the ship, during the contract, and the defendants thereafter supplied only the motive power.

One clause ran, in effect: The company will not be responsible for the acts of the master or crew of the tug or persons on board or for damage or injury, from whatever cause occurring, to the vessel towed. Mr. Brigntman argued that the tug was hired from the time she got under way from the dock, but his Lordship did not so think. That was to give too wide a meaning to the word "hiring" in the clause. In his view the parties did not intend the clause to cover such a state of facts. His Lordship thought the hire there contemplated started when the tug was actually towing. The clause referred to "the vessel towed." It would be impossible to suppose the tug was under the control of the tow if the tow were miles away and the tug was proceeding down the river to meet her.

The second clause said:—

These conditions of towage shall apply to any damages, injury or losses, from whatever cause, that may occur to the vessel requiring the tug or tender, or to the tug or tender, or to any other vessel or to any person on board, while the tug or tender is in attendance upon or engaged in any manœuvre for the purpose of making fast or after the towing line has been finally slipped clear from the vessel.

His Lordship ventured to think that at the time when the defence was settled by Mr. Brightman, he had in his mind as the proper line of defence—not the point that the tug was hired from a distant moment and was the servant of the tow, but the point that at the time of the collision the tug was "in attendance" on the *Elmdale* and was manœuvring for the purpose of making fast." His Lordship had to consider, from that point of view, whether the tug, in fact, was in attendance at the time of the collision or engaged in a manœuvre for the purpose of making fast.

Counsel had agreed that the Court was entitled to draw all reasonable and proper inferences which arose from the somewhat meagre statement of facts agreed. His Lordship hoped that Counsel, in agreeing that, had at least a limited confidence in the judicial knowledge by the tribunal of tugs and tows and their ways of conducting business; he stressed the word "limited." (Laughter).

In a case of this kind his Lordship thought one must have in mind several matters which were the proper bases for inference. In the first place, he had no reason to think that this manœuvre was otherwise than deliberate and that it had some objective. No suggestion was made to the contrary. That being so, he asked himself: What possible object had the tug except the object of getting into a position in which she could make fast? One tug was to make fast on the stern, and had gone down the side of the *Elmdale* for the purpose, so that the time for making fast had arrived.

The ship had come up on the flood and must have been within a quarter-ot-a-mile of the dock entrance. The tug had got to within 50-ft. of her, and his Lordsnip could conceive no reasonable explanation of this manœuvre except that the tug wanted to make fast to the bows of the ship. The most probable reason of the collision seemed to his Lordship to be that the tug either misjudged the distance she was from the tow, or did not put her wheel over hard enough or did not take her way off sufficiently. In any event, the result was the collision.

His Lordship had no doubt, in his own mind, that the tug at the time of the collision was "in attendance" on the ship and was engaged in a manœuvre for the purpose of making fast. That being so, he must hold that these towage conditions applied and that the defendants were absolved from liability. There would be judgment for the defendants and a decree that the action must be dismissed with costs.

Merseyside Dock Access

Appointment of Committee of Enquiry

The Minister of War Transport has announced the appointment of a committee under the chairmanship of Sir William Chamberlain, M.Inst.T., Regional Transport Commissioner, to report to him on measures which may be considered desirable to facilitate the working of the services in the Merseyside port area after the war.

The following are the members of the committee:—

Sir William Chamberlain, Regional Transport Commissioner (Chairman).
Mr. R. Howell Davies, Divisional Road Engineer.
Mr. M. J. Hellier, Regional Planning Officer.
Mr. R. J. Hodges, General Manager and Secretary, Mersey Docks and Harbour Board.
Mr. Ashton Davies, Railway Executive Committee.
Mr. H. Hamer, Liverpool City Engineer and Surveyor.
Mr. W. A. Harrison, Borough Engineer, Bootle.
Mr. B. Robinson, Borough Engineer, Birkenhead.
Mr. L. St. G. Wilkinson, Borough Engineer, Wallasey.
Mr. W. H. Barton, Liverpool District Trades Council.
Mr. W. A. Cornes, M.Inst.T., representing Joint Road Transport Organisations.

The terms of reference are:—

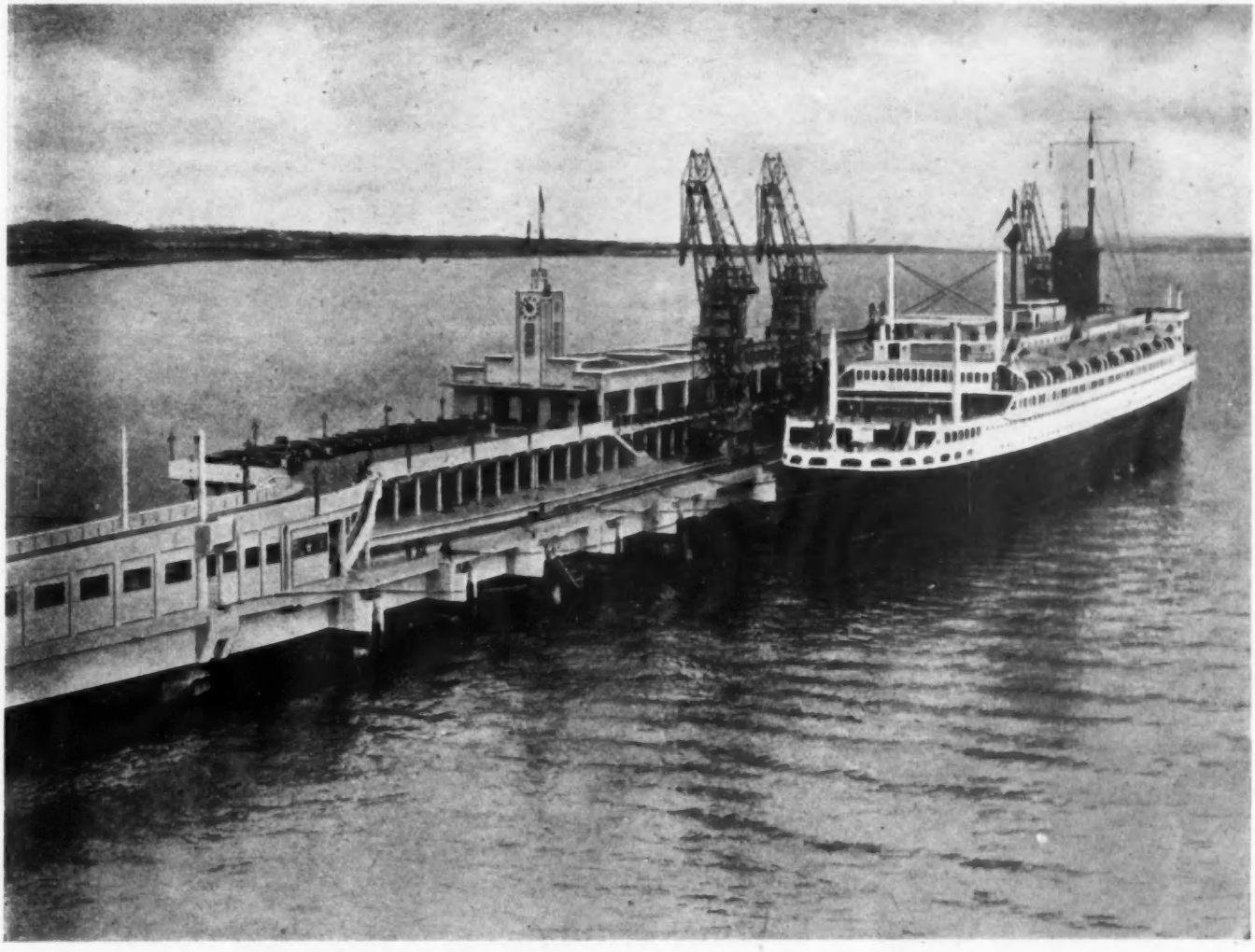
> To consider the transport facilities, accommodation and layout of the Merseyside port area on both sides of the river, and to submit proposals relating to post-war development with a view to more expeditious and economic handling of goods and services in the docks and to the improvement of the access thereto.

The ministerial circular adds that the members have been chosen specially for their expert knowledge of the problems of access to the Merseyside docks by road and rail and it is hoped that the report will be of great value, not only to the Minister, but also to the local authorities, Statutory Undertakers, and commercial interests which are intimately concerned with the welfare of the port. The Committee has been enjoined to make any special enquiries that it may find necessary to ensure that its recommendations will have due regard to the post-war planning problems that arise over the adjoining areas, as well as those of the port area itself.

The Institute of Transport and Book Salvage.

The Institute of Transport make the request that particulars of books and periodicals of transport interest, which individuals or firms intend for salvage, may be communicated to them before the material is finally sent for pulping. The Library of the Institute is stated to be short of many volumes of transport periodicals, particularly before 1927, and assistance in completing sets will be appreciated. The address of the Institute is 15, Savoy Street, London, W.C.2.

REINFORCED CONCRETE IN DOCKS AND HARBOURS



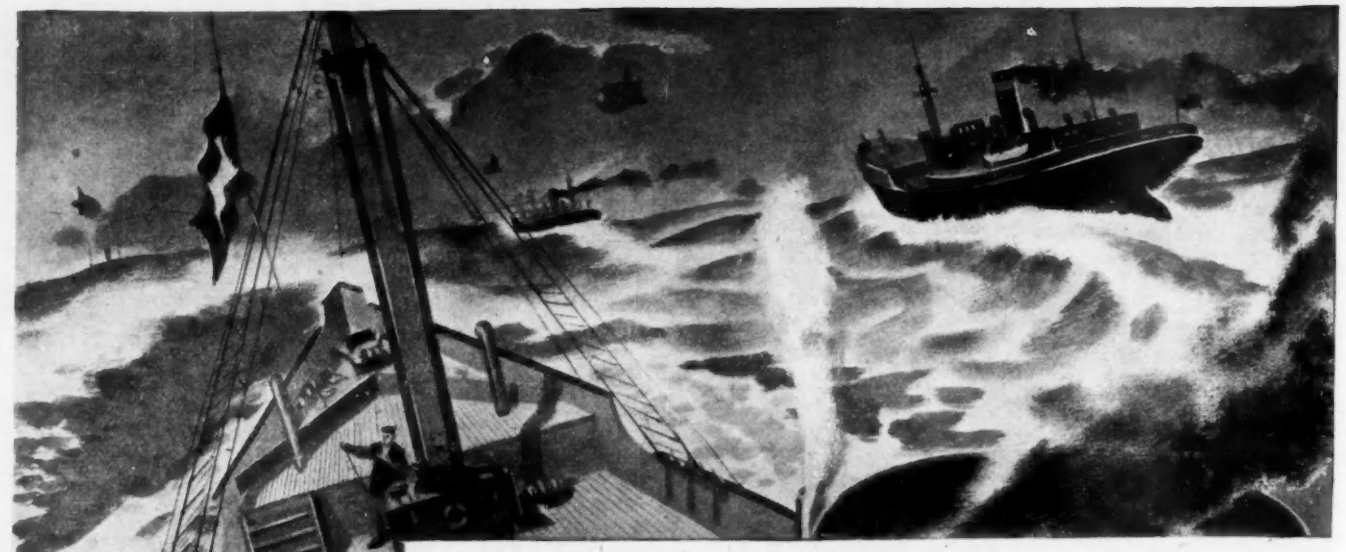
Reinforced Concrete Passenger Jetty at Verdon Docks, near Bordeaux.

Reinforced concrete dock and harbour structures have a high degree of resistance to corrosion by sea water. This quality, together with the durability and enormous load carrying capacity of reinforced concrete, makes the material particularly suitable for dock and harbour work. Furthermore, the monolithic nature of reinforced concrete renders major damage by impact almost impossible. There will be many extensions and much reconstruction of docks and harbours in the post-war years and for new berths, jetties, sea walls, warehouses and sheds, as well as for the reconstruction of existing buildings, reinforced concrete will be selected as the most durable and trouble-free material.

THE REINFORCED CONCRETE ASSOCIATION

94, PETTY FRANCE · LONDON, S.W.1.

Telephone: Whitehall 9936.



APPOINTMENT FULFILLED-
THANKS TO *Smith* CRANES

Smith Cranes are loading for victory in ports and harbours to-day all over the civilised world; working faster than ever before but with unfaltering efficiency. Smiths make all types of Cranes, and have over 100 years of experience behind them. Send your enquiries to Rodley, Leeds.

SMITH CRANES
AND EXCAVATORS

THOMAS SMITH & SONS (RODLEY) LIMITED · RODLEY · LEEDS

SPECIALISTS IN THE DESIGN AND MANUFACTURE OF CRANES AND EXCAVATORS

PERILOUS LANDFALL

"THE TIMES ARE DIFFERENT, the stake is not saving one's tides or dodging the main stream of colliers . . . but something more profound." So wrote the Master of a British coastal vessel and we have no doubt that other Masters will agree with him.

THE TIMES *are* different. Ask the Captain who spends twenty hours on the bridge when his ship runs into fog as thick as a blanket and he must observe 'radio silence' . . . the Captain who gropes towards the pilot through unaccustomed channels and between the darkened buoys . . . the Captain whose constant companion is the new fear of being unable to keep up with the convoy.

Modern navigational instruments are helping these men. Developed in peace, the HUGHES Recording Echo Sounder is proving invaluable in war. It enables the Navigating Officer to fix his position on the chart at any time, during dense fog or when sights cannot be taken. *It is significant that ships fitted with the Echo Sounder are being systematically placed in positions in convoy, where they can take under their wing the vessels without them.*

THE HUGHES RECORDING ECHO SOUNDER, when used for navigating purposes, takes soundings at the rate of approximately 90 a minute and presents a continuous profile of the sea-bed by the Graph Recorder on the bridge. To-day the soundings on British Admiralty Charts are taken with the Hughes British Admiralty Sounder and it is obvious that the combined use of instrument and chart constitutes the greatest single aid to navigation yet devised.

KELVIN, BOTTOMLEY & BAIRD LTD. * HENRY HUGHES & SON LTD.

associated as

MARINE INSTRUMENTS LTD

107 FENCHURCH STREET · LONDON · E.C.3

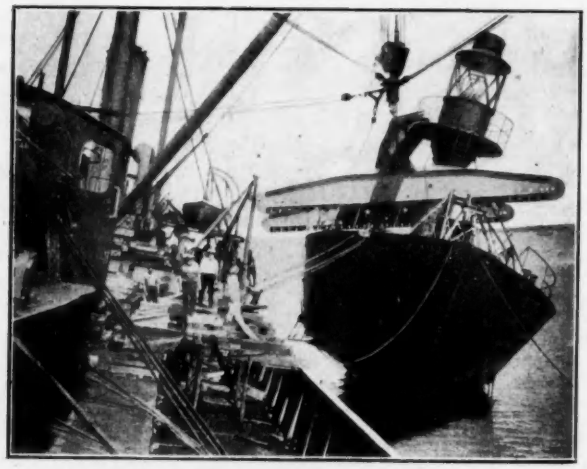
who, together with the entire Nautical Instrument Trade, to-day serve this one end:

TO PROVIDE SEAMEN WITH EVERY MODERN NAVIGATIONAL AID THAT ADDS TO THEIR SAFETY AND CONVENIENCE

THE AGA SYSTEM

FOR ALL AUTOMATIC NAVIGATION LIGHTS

LIGHTHOUSES - LIGHTSHIPS - BEACONS - BUOYS - FOG SIGNALS

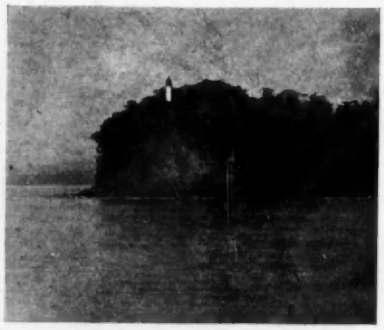


LIFTING FOR TRANSPORT OVERSEAS

A LIGHT VESSEL FITTED WITH AGA AUTOMATIC LIGHT AND FOG BELL TWELVE MONTHS UNATTENDED SERVICE PERIOD

CEYLON

CONVERTED TO THE AGA SYSTEM TO AFFORD TWELVE MONTHS AUTOMATIC UNATTENDED OPERATION



WEST AFRICA

AN AGA INSTALLATION WITH DALEN LIGHTING APPARATUS FOR AUTOMATIC OPERATION

AN AGA LIGHT VESSEL IN EASTERN WATERS

PROVIDING 12 MONTHS UNATTENDED SERVICE PERIOD FOR BOTH LIGHT AND FOG BELL

CONTRACTORS TO:—

The Admiralty.
Trinity House.
Northern Lighthouse Board.
The Air Ministry.
The War Office.
The India Office.
The Crown Agents for the Colonies.

THE GAS ACCUMULATOR CO. (U.K.) LTD.,
LIGHTHOUSE ENGINEERS,
BEACON WORKS,
BRENTFORD, ENGLAND

The West India Docks, London

Discovery and Opening of Foundation Stone

A ceremony, or perhaps two ceremonies, of no little importance in the history of the Port of London, took place towards the end of February. At the first ceremony on February 18th, the recently discovered foundation stone of the West India Docks and Warehouses, originally laid on July 20th, 1800, by Lord Loughborough, at that time Lord Chancellor, and Mr. William Pitt, the celebrated statesman, jointly with Mr. George Hibbert and Mr. Robert Milligan, chairman and deputy chairman of the West India Docks Company, was opened in the presence of the Right Hon. Thomas Wiles, chairman of the Port of London Authority, at an official gathering, including Mr. L. H. Bolton, the vice-chairman, Admiral Sir Alan Hotham, chairman of the Maintenance Committee, Sir Arthur Cory-Wright, chairman of the Dock and Warehouse Committee, Sir Douglas Ritchie, general manager and Mr. W. P. Shepherd-Barron, M.Inst.C.E., chief engineer.

The Chairman (Rt. Hon. Thomas Wiles) and members of the Port Authority, with officials, at the Opening of the Foundation Stone.

The stone was discovered about 10-ft. below the present ground level, and it is believed that it indicates the level of the marsh in 1800. It is a rectangular block of Portland Stone, 3-ft. 3-in. long, 3-ft. wide and 4-ft. 3-in. high. Including its contents it weighed $2\frac{3}{4}$ tons. On being opened, two large glass bottles were found, over which was a copper plate engraved with the names of the directors of the West India Dock Company. One of the bottles was later found to contain two inscribed rolls of vellum, one in English and the other in Latin; the second bottle contained a number of gold, silver and copper coins.

The inscription on the vellum is as follows:—

Of this Range of Buildings
Constructed, together with the adjacent Docks,
At the Expence of public spirited Individuals,
Under the sanction of a provident Legislature,
And with the liberal co-operation of the
Corporate Body of the City of London,
For the distinct Purpose
Of compleat SECURITY and ample
ACCOMMODATION
(hitherto not afforded)
To the SHIPPING and PRODUCE
of the WEST INDIES at this wealthy PORT
THE FIRST STONE WAS LAID
On Saturday the twelfth day of July,
A.D. 1800
By the concurring hands of
THE RIGHT HONOURABLE
LORD LOUGHBOROUGH
Lord High Chancellor of Great Britain,
THE RIGHT HONOURABLE
WILLIAM PITT
First Lord Commissioner of his Majesty's
Treasury, and Chancellor of his Majesty's
Exchequer,
GEORGE HIBBERT Esq. the CHAIRMAN
and
ROBERT MILLIGAN Esq.
the Deputy CHAIRMAN of the
WEST INDIA DOCK COMPANY.
The two former conspicuous in the Band
of those illustrious Statesmen
Who in either House of Parliament have
been zealous to promote,
The two latter distinguished among
those chosen to direct
AN UNDERTAKING
Which, under the favour of GOD,
shall contribute
STABILITY, INCREASE, and ORNAMENT
to
BRITISH COMMERCE.

The second ceremony took place on February 25th, at the offices of the Port of London Authority, where the two glass bottles recovered from the foundation stone were opened, at a meeting of the Authority, by the chairman, Mr. Thomas Wiles. The square one contained 27 coins ranging from guinea gold pieces to a copper farthing, including silver twopenny-pieces. The round bottle contained, as already mentioned, copies of an inscription in English and Latin. A manuscript record also found in one of the bottles disclosed the hitherto unknown fact that William Adam, one of the four brothers who built the old Adelphi Buildings, was the builder of the warehouses.

The photograph showing the group present at the first ceremony has been kindly supplied by the Port Authority.

Grand Union Canal Company's Powers

The Grand Union Canal Company have presented a private Bill to Parliament containing a clause which will confer powers upon the Company of financing other companies engaged in transport, whether by land, sea or air, likely to increase the traffic on the canal. The title of the Bill is "A Bill to make better provision for regulating the capital of the Grand Union Canal Company and the administration of their affairs; to confer further powers on the Company; and for other purposes."

It may be recalled that, in 1937, the Regent's Line, a subsidiary of the main Company, inaugurated a service between this country and the Continent, whereby all classes of cargo could be carried by barge from points touched by the Grand Union Canal, transhipped at the Company's Regent Canal Dock, London, into a vessel of the Regent's Line, in which it was carried to Antwerp, and there transhipped into lighters owned by a Belgian subsidiary for distribution throughout Belgium, Southern France and Switzerland. This shipping service led to an action against the Grand Union Company by certain shipping competitors who claimed that it was outside the powers of the Grand Union Company to be interested in such a service. It is believed that the action is still pending and that the investment clause introduced into the present Bill is intended to remove any ambiguity as to the Grand Union Company's powers.

The Bill came recently before the House of Lords in Committee, when the investment clause was opposed by the Chamber of Shipping, but, after a long hearing, the clause was allowed in full.

WANTED.

Copies of "The Dock and Harbour Authority," from July, 1941, to February, 1943, are urgently needed. 19, Harcourt Street, W.1.

Model-Prototype Conformity with reference to a Dry-Dock Suction Chamber

By C. B. PATTERSON, Jun., A.M.Soc.C.E.

Synopsis

This paper, one of a series in a symposium which deals with the analyses of model and prototype data and considers whether they could be based upon direct quantitative comparisons, is devoted to a study wherein, due to the lack of certain measurements in the prototype, the comparison of model and prototype performance was approached from an inductive standpoint. The problem under investigation was the unsatisfactory operation of pumps used to drain a large dry dock; the medium of study was a 1 : 10-scale model constructed at the Waterways Experiment Station.

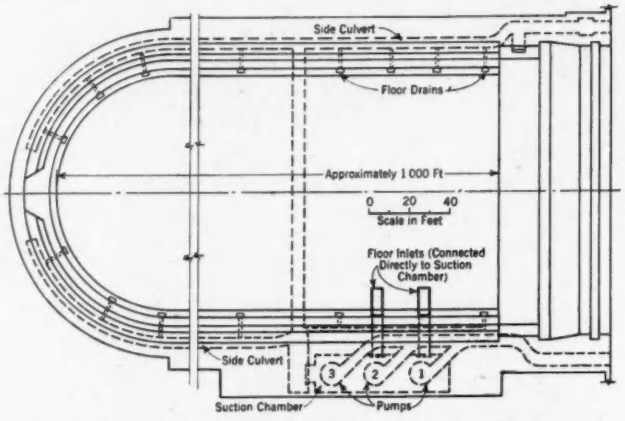


Fig. 1. General Plan of Dry Dock Showing Culvert System and Suction Chamber.

The dry dock, together with its culvert system and suction chamber, is shown by the general plan drawing in Fig. 1. (Interconnecting passages to the suction chamber from adjacent dry docks are not shown). The suction chamber is shown in greater detail in Fig. 2, and the arrangement of pump intakes (1, 2 and 3) and sluice gates (3, 4 and 5) is indicated. This arrangement,

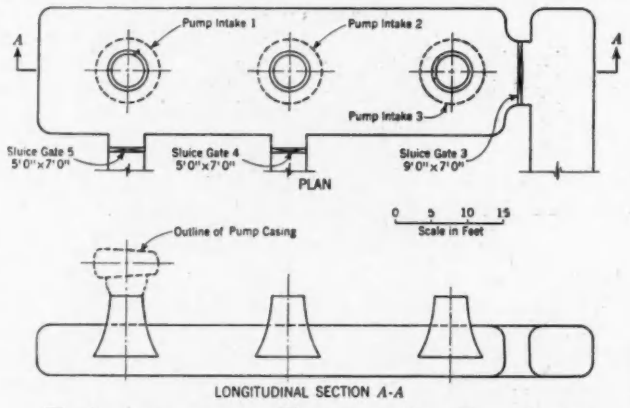


Fig. 2. Arrangement of Elements within a Pump Suction Chamber.

the high rate of discharge (130,000 gallons per minute maximum per pump), and the limited dimensions of the suction chamber, gave rise to unstable and sometimes violent flow conditions, which were manifested at the pumps by vibration, loss of capacity, and symptoms of cavitation. (All such objectionable features will be covered by the general term " rough operation "). Test runs in the prototype yielded notes and observations as to the character of pump performance, but did not provide any numerical data or evidence as to the character of flow within the suction chamber.

In constructing a model for the investigation, it was essential that the proper distribution of flow through the three sluice gates be assured. Accordingly, the entire system of hide culverts and inlets was reproduced in the model. It was not feasible to reproduce the prototype pumps by means of miniature pumps of a homologous series; however, the proper metered discharges were induced through the intakes by ordinary centrifugal pumps. For purposes of visual observation, the suction chamber and pump intakes were made of transparent pyralin.

To gain some idea as to flow conditions within the suction chamber, compressed air was injected into the model under operating conditions similar to those known to give unsatisfactory pump operation in the prototype. From observations of the air bubbles in these preliminary tests it was learned (a) that flow entering the suction chamber from the sluice gates created initial rotation about one or another of the pump intakes (depending upon the particular conditions of operation), and (b) that initial vortices so formed were accentuated as the water was drawn upward into the bellmouth intake. Under such conditions it was reasonable to expect that the pressure at the axis of any intake so affected (that is, at the centre of the vortex) would frequently fall below the suction lift capability of the pump. It was concluded that the rapid and violent fluctuations of pressure attending vortex action within the intakes were responsible for an alternate breaking and restoring of suction head at the pumps, resulting in the afore-mentioned symptoms.

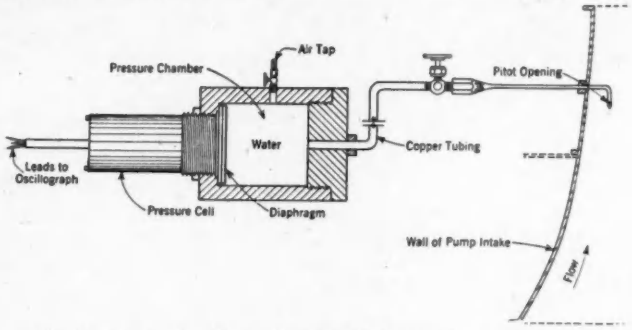


Fig. 3. Device for Measuring Rapid Fluctuations of Pressure.

To support this conclusion, and to provide a basis for the comparison of model and prototype performance, it was desired that a record be made of the amplitudes and frequencies of pressure fluctuations within the pump intakes. It was believed that such data would permit the establishment of a criterion for pump operation, whereby rough pump operation would be revealed by a record showing fluctuations of great amplitude and frequency, and whereby smooth operation would be indicated by slight variations of pressure. From such a criterion, the model reproduction of prototype performance could be confirmed, and the effectiveness of any corrective measures under trial could be evaluated.

To obtain a record of pressures within the suction bells, the instrument shown in Fig. 3 was devised. The operation of this instrument is very simple: Pressure impulses originating at the pitot-tube opening are transmitted through the confined liquid in the tubing to the face of the pressure cell; the resulting deflections of this diaphragm are recorded electrically by an oscillograph to give a continuous time-record of the instantaneous values of pressure.

Using this instrument the model was run under each operating condition—combination of pumps and sluice gates in operation—for which observations had been made in the prototype. Oscillograph records taken during a few such tests are plotted in Fig. 4; and for each of the test conditions the observations made under comparable conditions in the prototype are recorded in Table 1. (In Fig. 4, and all other figures, dimensions are expressed in terms of prototype equivalents). By comparison of model and prototype observations it may be seen that they are consistent in all

*Reproduced from the Proceedings of the American Society of Civil Engineers.

Model-Prototype Conformity with reference to a Dry-Dock Suction Chamber—continued

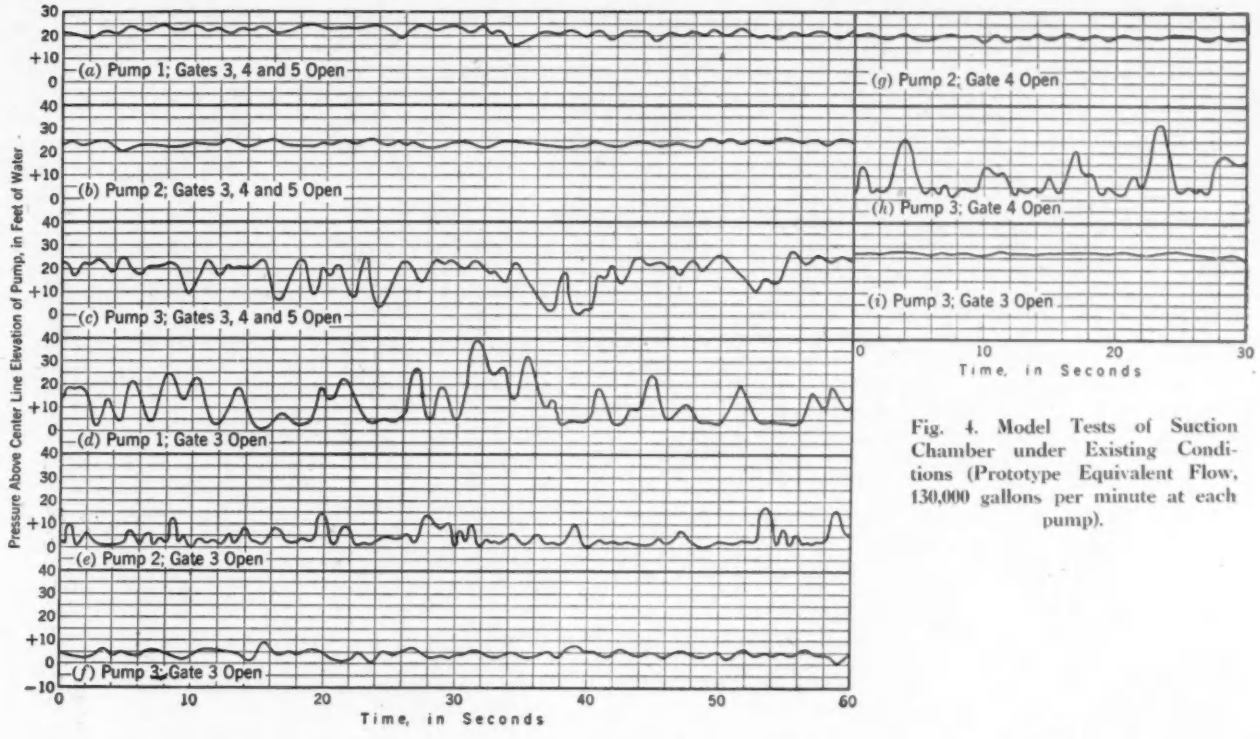

(a) Pump 1; Gates 3, 4 and 5 Open
(b) Pump 2; Gates 3, 4 and 5 Open
(c) Pump 3; Gates 3, 4 and 5 Open
(d) Pump 1; Gate 3 Open
(e) Pump 2; Gate 3 Open
(f) Pump 3; Gate 3 Open
(g) Pump 2; Gate 4 Open
(h) Pump 3; Gate 4 Open
(i) Pump 3; Gate 3 Open
Pressure Above Center Line Elevation of Pump, in Feet of Water
Time, in Seconds

Fig. 4. Model Tests of Suction Chamber under Existing Conditions (Prototype Equivalent Flow, 130,000 gallons per minute at each pump).

cases. Furthermore, the criterion for rough and smooth pump performance is definitely established. From such a model-prototype comparison it was safe to assume that predictions as to the effectiveness of corrective measures could be relied upon.

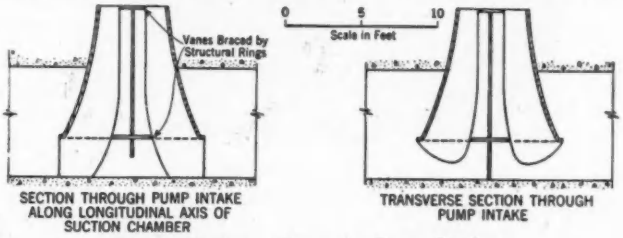

Vanes Braced by Structural Rings
Scale in Feet
SECTION THROUGH PUMP INTAKE ALONG LONGITUDINAL AXIS OF SUCTION CHAMBER
TRANSVERSE SECTION THROUGH PUMP INTAKE

Fig. 5. Design of Vanes for Pump Intakes.

TABLE 1

Test Conditions for Model Observations in Fig. 4

(Discharge 130,000 gallons per minute)

Fig. 4	Sluice gates open	Pump operating	Corresponding prototype observation
a	3, 4 & 5	1	
b	3, 4 & 5	2	
c	3, 4 & 5	3	Operation very rough
d	3	1	Extremely bad operation
e	3	2	Generally unsatisfactory operation
f	3	3	With more than one pump operating on Sluice Gate 3 the farthest unit could not operate; generally unsatisfactory operation
g	4	2	Under initial conditions Pump 2 operated satisfactorily
h	4	3	Operation very rough
*i**	3	3	When Pump 2 was shut down, power input to Pump 3 decreased
			When Sluice Gate 3 was opened power input to Pump 3 decreased again and its operation was good

* Initially (see Figs. 4*g* and 4*h*) pumps 2 and 3 were discharging 130,000 gallons per minute with Sluice Gate 4 open. Then (see Fig. 4*i*) Pump 2 was was shut down and Sluice Gate 3 was opened.

It was considered that the unsatisfactory performance of the pumps would be improved if the vortices in the intakes could be broken up. For this purpose, vertical vanes of the design shown by Fig. 5 were installed in the model pump intakes. In order that flow and longitudinal direction be unobstructed, transverse vanes were not extended to the floor of the model suction chamber. In the prototype, however, all vanes are extended to the floor. The results of a model test run with these vanes in place are shown in Fig. 6. By comparing these results with those of Fig. 4, the improvement is evident, and a smooth operation of the pumps is indicated. Modifications of the basic design vanes were also tested, but no improvement over the basic design was found.

Accordingly, vanes of the basic design were adopted for installation in the prototype. As a final step in the analysis, the model predictions were thoroughly substantiated by the prototype; it is reported that operation of the pumps, following installation of vertical vanes in the intakes, has been entirely satisfactory. A complete model-prototype confirmation would include the measurement of pressure fluctuations in the prototype but thus far such measurements have not been practicable.

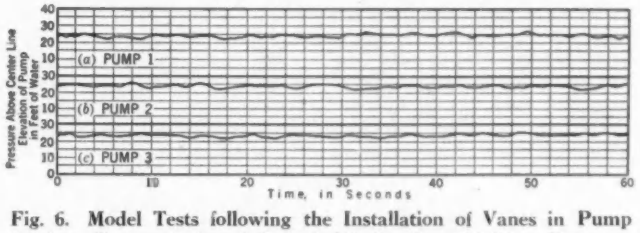


Fig. 6. Model Tests following the Installation of Vanes in Pump Intakes (Pumps 1, 2 and 3 each Discharging 130,000 gallons per minute; Sluice Gates 3, 4 and 5 Open).

Spanish Harbour Developments.

Various works are in progress at harbours on the Coast of Spain. At Barcelona, repairs of war damage to quays and equipment are in hand and the breakwater and the East Mole are being lengthened. At Seville, the Tablara Mole is being extended and the entrance channel has been dredged to a uniform depth of 7 metres. At Cadiz, a new dry dock has been opened. At Palma de Mallorca, work on the new harbour and fishery basin has been continued.

The Glamorganshire Canal

Impending Closure of a Notable Inland Waterway

The following description of the Glamorganshire Canal, the impending closure of which is referred to in this month's Editorial Comments, is extracted from a notice in a recent issue of *Modern Transport*.

In its 25 miles from Merthyr to the sea the canal descended 560-ft., with some fifty locks. The sea lock was the first, and for a long time the only, lock entrance from the sea in the Principality, the next sea lock to be constructed in Cardiff being that of the Bute West Dock, opened in 1839. The canal had thus the distinction of being the first Welsh effort to overcome the disadvantages of the extreme variation of tides in the Bristol Channel by providing berths where sea-going vessels could always lie afloat.

The sea lock, when opened in 1798, was 97-ft. long by 27-ft. wide, with an average depth of water on the inner sill of 13-ft. Vessels of 150 to 200 tons burthen could be accommodated through the lock. At the time this was considered a large type of vessel. Subsequently, the length of the lock was increased to 120-ft., its present dimension.

The canal was, no doubt, for its day, a bold undertaking. It certainly gave a great impetus to the shipping business at the then small harbour of Cardiff, particularly in the iron and coal trades. Prior to the construction of the canal, coal and iron had to some extent been brought down to the coast by road. A local writer early in the nineteenth century, recalling the opening of the canal, says: " It was then found that each barge with its load of 24 tons, drawn by one horse, and attended by a man and a boy, brought down just as much as had previously occupied 12 wagons, 48 horses, 12 men, and 12 boys."

Business appears to have been brisk from the start, and many hundreds of sailing vessels took their cargoes in the canal, and the development of trade, particularly in the shipment of coal, brought about by the canal, led to the construction of the docks at Cardiff, although this action was stimulated by railway development. When the first of the great system of docks at the port was made—i.e., the Bute West Dock, opened in 1839—a water communication cut from the canal to the dock was provided at the same time. Thus barges brought cargoes down the canal and passed into the West Dock, so as to feed the larger vessels that could be accommodated there as compared with the canal basin itself.

Traffic on the canal continued active, despite the establishment and further development of the docks. A sea coasting trade, with both steam and sailing vessels, has been maintained up to comparatively recent years, but little or no barge traffic has passed down the canal from inland for a very long period. At present, as for some years past, the main business is the accommodation of small steam sand-suckers, bringing in sand and gravel from the bed of the Bristol Channel. A certain amount of timber is also floated from the docks (by means of the communication cut referred to above) to canal-side timber yards. The northern part of the canal, from Merthyr down to Abercynon, about half its length, was closed about 20 years ago.

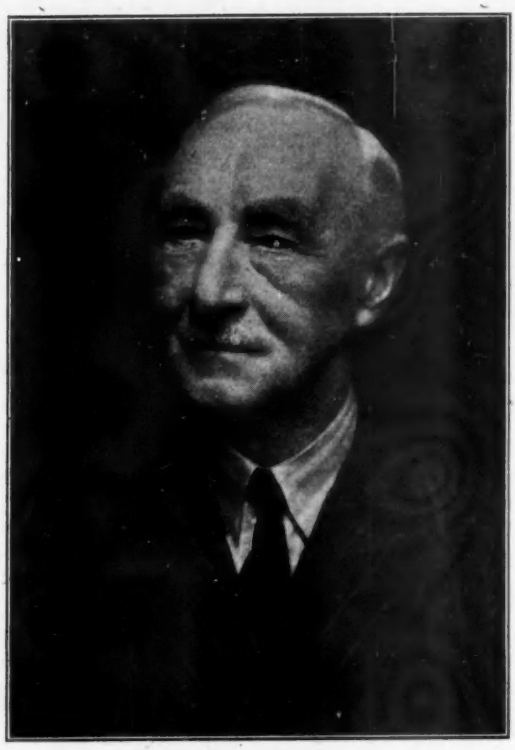
Grimsby Chamber of Commerce and Port Trade.

At the recent annual meeting of the Grimsby Chamber of Commerce and Shipping, Mr. T. L. Goulton said that the Port had been standing still for many years and, in his opinion, one of the reasons it had lost important trade that formerly came there, was the amalgamation of the railway companies. He envisaged future legislation allocating particular trades to particular ports, and urged that every effort should be made not only to safeguard and foster existing trade, but also to prepare and provide post-war facilities, so that Grimsby could compete with any other port on the East Coast. After some further discussion by members, the Council of the Chamber was asked to explore the whole position and make recommendations regarding the formation of a special committee and to report to an extraordinary meeting of the Chamber.

Notable Port Personalities

XXXIII—Mr. Hugh Rose, C.A., J.P.

Mr. Hugh Rose, after his early training as a Chartered Accountant, became a member of the Edinburgh Society of Accountants in 1902, and, thereafter, entered the Family Firm of Messrs. Craig & Rose, Ltd., Paint and Varnish Manufacturers, who have an extensive business connection all over the country and abroad.



Mr. HUGH ROSE, C.A., J.P.

In 1923, Mr. Rose was appointed a member of the Leith Dock Commission as a representative of the Dock Ratepayers, becoming Convener of the Finance Committee in 1932 and Chairman of the Board in 1942, a position which he still holds.

Mr. Rose's family have been connected with the Leith Dock Undertaking for a long period, his grandfather having been Treasury representative on the Commission in 1876.

For three years Mr. Rose was Chairman of the Leith Chamber of Commerce, and for twelve years was on the Board of Management of Leith Hospital. He is connected with many public companies in Edinburgh, being a Director of The North British Rubber Co., Ltd., The London and Edinburgh Shipping Co., Ltd., and the Northern Assurance Co., Ltd.

In his younger days Mr. Rose took a keen interest in the local Territorial Battalion of the Royal Scots Regiment, and during the last war was on active service in France, rising to the rank of Lieut-Colonel and Commanding Officer of the 3rd/7th Battalion of that Regiment.

Retirement of Harbour Master.

On reaching the age limit, Mr. Rattray, harbour master at Methil Docks on the East Coast of Scotland, has retired from the service of the dock-owners, the London and North Eastern Railway.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export

*Range-Action in Harbours**

By GEORGE STEWART, M.Inst.C.E.

Introduction

The experiments described in this Paper were carried out with the object of investigating the causes of range action and means of minimising range action in harbours.

The Author holds the view that valuable information with regard to range problems involved in the design of harbours can be obtained from the use of models. With this object in view, he has constructed models, and carried out a series of experiments in the Civil Engineering laboratories at the University of Cape Town.

Since Cape Town Harbour presents certain unsolved problems of range, it has been used as a basis.

Before giving details of these experiments, it is necessary to outline the development of Table Bay harbour, and the efforts that have been made to minimize range, known locally as " run."

Before the late Sir John Coode, K.C.M.G., Past-President Inst.C.E., designed the breakwater and harbour works at Table Bay in 1860, many attempts were made to build breakwaters and carry out schemes to protect shipping in Table Bay. Though each had some useful object in view, all failed to meet both the mercantile and nautical requirements. In 1880, Sir John Coode made a Report recommending additional works at Cape Town to diminish " run " into the docks, and to meet the greatly increased trade of the port, but he died before the completion of the works he had proposed, which added 62 acres of enclosed water area, and some 5,000-ft. to the length of the quayage. The late Sir William (then Mr.) Matthews, K.C.M.G., Past-President Inst.C.E., of the firm Coode, Son and Matthews, inspected and reported on the works. In order to minimize " run " he proposed, instead of finishing the South Pier with an oblique arm or cant, as was formerly intended, to extend the inner portion of the work farther east, and to terminate it with an elbow placed at a right angle to the main arm. After the completion of these works, " run " still occurred.

Since then, the scheme proposed in 1901 by the late Mr. C. W. Methven, M.Inst.C.E., and Mr. R. H. Hammersley-Heenan, M.Inst.C.E. (1)† to extend the breakwater and construct a new harbour has, with little modification, been carried out, and the " run " in this new basin is proving a difficult problem to the harbour authorities.

"Run" or "Range" Action.

" Run," synonymous with " range," was the term used by the late Sir John Coode in his harbour reports in 1880 to indicate the apparent lateral movement of the water in the enclosed harbour areas, and this term is still used in local shipping circles. Its synonym, " range," has already been explained and discussed in the Minutes of Proceedings of the Institution.[2]† Range waves in a harbour cause vessels to develop a backward and forward motion, as a result of sea action. The maximum height of range waves measured by the Author in Cape Town Harbour is 3-ft. 6-in. in the Victoria Basin, and 3-ft. in the New Basin. In 1900, the height of range wave given in a report by Mr. R. H. Hammersley-Heenan was 3-ft. in the Victoria Basin, and 2-ft. 6-in. high in the Alfred Basin.

The importance of the reduction of range action at Cape Town may be realised from the fact that, on occasions, it develops to such a degree that vessels have had to leave the harbour and go out into Table Bay for safety.

Weather Conditions Under Which Range Occurs.

Range occurs in the enclosed basins of Table Bay Harbour under two weather conditions, namely:—

1. A swell in and near Table Bay caused by distant wind or storm
2. A wind from the north-west during winter gales.

Beyond these facts, little is known as to the cause of range, and it has been looked upon as some kind of phenomenon which had to be endured. The general opinion advanced by experienced engineers and mariners using the harbour is that it is due to reflection of wave energy from the beach.

Experiments on Models Using Smoke in a Fluid Flow Analyser.[3]

The first experiments were carried out with $\frac{1}{8}$-in. flat rubber models using smoke in a fluid flow analyser, to determine the direction of stream-lines. A model was made with no beach surrounding Table Bay and smoke was drawn in a north-westerly direction past the breakwater towards the beach boundary.

These investigations showed stream-lines passing the end of the breakwater towards the beach but diffusing towards and into the entrance of the new harbour basin. They travelled in a circular direction towards the West Quay, and then turned to the South arm, returning towards the new harbour entrance.

Contour Models.[4]

Next, the Author, carried out experiments on a contoured harbour model to a horizontal scale of 1-in. = 200-ft., and a vertical scale of 1-in. = 16-ft., which was placed in a hydraulic flume with glass sides.

From these experiments the directions of stream-lines were determined with and without reflection of wave energy from the beach towards the harbour entrance and breakwater. To deflect the deflected energy, a jetty projecting from the new mole in an easterly direction and near to the harbour entrance was added to the model. The effect of this jetty was recorded by adding milk to the water and taking photographs.

These experiments were sufficient to show that range in the enclosed harbour basins was caused by: (1) wave reflection from the beach; and (2) lateral wave or swell action extending from waves or swell passing the breakwater, travelling towards the two harbour entrances and entering them in a westerly direction.

In order to establish these findings more precisely, and to investigate the effect of the proposed structures and eliminate range, a larger model to a scale of 1-in. = 100-ft. (horizontal) and 1-in. = 100-in. (vertical) was made in a tank 14-ft. long and 8-ft. wide. The scale of the model was limited by the dimensions of the tank, which was the largest that could be fitted up with the research funds available.

The scales and reduction gear used to produce waves were designed to produce swell with a limiting period of 8 minutes. The velocity of propagation of such a wave is proportional to the square root of the depth of the water through which it travels.[5]

The times required for waves to traverse corresponding distances in the model and in the harbour are proportional to the horizontal scale ratio. If L and H denote horizontal and vertical distance, and small letters refer to the model,

$$\frac{t}{T} = \frac{1}{L}\sqrt{\frac{H}{h}}$$

Therefore phenomena occurring in time, t, in the model occur in time 120t, in the harbour. As it was impossible to produce waves solely by the wind, as in nature, a wave-making machine was fitted at one end.

Wave Machines[6]

The best of several wave-making machines tested consisted of an inclined board hinged on a plate at the bottom of the tank, and given a backward and forward movement. This motion was obtained and varied by connecting the wave board to an adjustable eccentric link plate in the side of a vertical cast-iron disc 12-in. diameter and 1-in. thick.

The vertical cast-iron disc, fitted with a central shaft and pulley, was mounted on bearings, belt-driven from a direct-current motor, all arranged on a movable frame, and connected to the wave board by a connecting rod.

Care has to be taken to arrange the mechanism so as not to move the wave board at too acute an angle to the floor of the tank on the mechanism side of the wave board; otherwise too much lift is given to the water. The minimum angle was found to be 80 degrees.

A plane wave board creates not only a forward wave but also a transverse wave across the face of the board. To eliminate the transverse wave, a projecting board was fixed on to the inclined

*Reproduced by permission of the Council of the Institution of Civil Engineers.

†The numeral references are to the bibliography in the Appendix.

Range-Action in Harbours—continued

wave board at an angle of 65 degrees to it just below the water surface.

A great advantage of this arrangement is that the wave board and driving mechanism can be easily moved to produce waves at any angle to the fixed model.

In addition to this, the amount and speed of the backward and forward movement can be readily varied, thereby producing waves of different heights, lengths, and periods.

The water-level during tests was kept constant, since Cape Town has a range of only 5-ft. at Spring tides. The current in Table Bay is also negligible.

Range Problem in Harbour Basins

The problem at Cape Town is to design some form of structure to reduce range action in both harbour basins. According to weather conditions range action may be severe in both basins or in one alone. Range action has been eliminated at Blyth Harbour, Northumberland, by the construction of wave-traps and a spending beach. The Author, who had experience there, finds the range action at Cape Town is very similar to that which occurred at Blyth. The range periods at Blyth varied between 40 seconds and 150 seconds, whilst at Cape Town the periods may be as long as 8 minutes. This is due to the longer swell experienced off the Cape—known as the " Cape rollers."

Experimental Conditions and Results

The tank experiments were carried out using wave-periods corresponding as closely as possible with actual harbour conditions, and were checked throughout by observations made at the harbour during range periods. The Author's observations of range at Cape Town have extended over a period of 25 years. Range conditions were created in the model similar to those experienced in the harbour basins. The experiments show that *swell* and *not sea* is the direct cause of range in the sheltered basins in Cape Town Harbour. The combination of a rough sea and heavy swell, coming from the north-west to north, causes the greatest range action. From experiments on the model when the wave-period approaches 3 minutes, range basins begins to appear and is equal in both harbour basins. As this period increases the range disappears in the Victoria Basin and commences in the new basin. Finally, the range occurs in both basins with a range period of 3.6 minutes and continues until the period approaches 8 minutes, when range appears to fade out. Full experimental details are omitted for the sake of brevity, but the following are the chief conclusions reached:—

Conclusions

1. Sea alone does not appreciably cause range. Swell, with a rough sea and a north-westerly wind together cause the worst range period.
2. Waves with short periods have no effects in either harbour basin.
3. As the wave periods increase the range effect first occurs in both basins, then disappears from the new basin, and continues in the old basin.
4. The principal cause of range is wave reflection from the beach towards the breakwater.
5. When range action occurs in the Victoria Basin only, a recurring wave is created in a position about 2,000-ft. south of the entrance to the new basin.
6. When range occurs in the new basin the position of the recurring wave referred to in paragraph 5 moves towards the new basin entrance.
7. The position of the recurring wave directly effects range action in both basins.
8. When range action occurs in the Victoria Basin only, the height of water-level in the bight at the junction of the breakwater is noticeably increased.
9. Spurs, groynes, or wave traps built out on either or both sides of the harbour basin entrances do not appreciably decrease range action.
10. Extending the existing breakwater 1,500-ft. either in its present line or to form a re-entrant angle does not appreciably reduce range action.
11. An island breakwater near to the end of the existing breakwater is ineffective.
12. The replacement of part of the breakwater in the bight by an open structure increases range action.
13. **A breakwater extending across the bay from the Milnerton beach to the end of the existing breakwater is the most effective preventive of range action.** (See Fig. 1).
14. This breakwater, in addition to reducing range action in two existing large harbour basins, would provide a large sheltered anchorage and harbour for future development. Its length would be approximately 13,000-ft., and it would be partly in deep and partly in shallow water.
15. The position of the entrance in the proposed new breakwater is of major importance. It should be at least 1,800-ft. from the existing breakwater.

Acknowledgment

Grateful acknowledgment is expressed for a grant from the Staff Research Fund of the University of Cape Town which defrayed the cost of various models.

The Paper is accompanied by one diagram, from which Fig. 1 has been prepared.

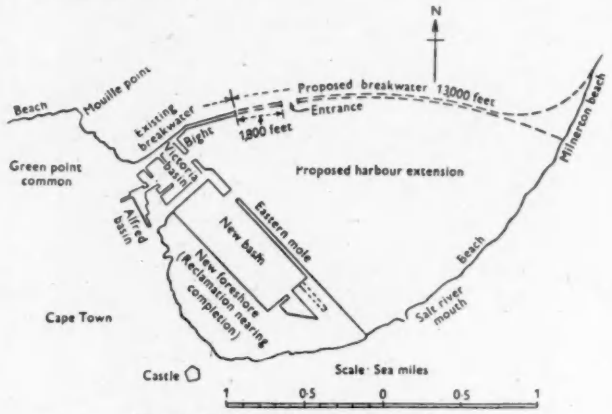


Fig. 1. Plan of Cape Town Harbour.

Appendix: Bibliography

1. C. W. Methven and R. H. Hammersley-Heenan. " Report on Cape Town Harbour, Table Bay Harbour Board," 1902. C. W. Methven, " The Harbours of South Africa," Min.Proc.Inst.C.E., Vol. clxvi (1905-6), Part iv., p. 4.
2. " Reduction of Wave Action in Harbours," Min.Prac.Inst. C.E., Vol. ccix (1919-20), Part i, pp. 24, 40, 41.
3. H. L. Parr. " Fluid Flow Analyser," Mech.Eng., June, 1937, pp. 437-439.
4. Professor A. H. Gibson. " Tidal and River Models," Journal Inst.C.E., Vol. 3 (1935-6). Supplement p. 699 (Oct., 1936).
5. Professor A. H. Gibson. " Use of Models in Hydraulic Engineering."
6. Col. Earl I. Brown. " Wave Tank Experiments," Eng. News Record, Vol. 120, p. 29.
7. Sir Horace Lamb. " Hydrodynamics," 6th Edition. Chapter ix., 1932.
8. Major R. A. Bagnold. " Beach Formation by Waves: Some Model Experiments in Wave Tanks," Journal Inst.C.E., Vol. 15 (1940-41), p. 27 (Nov., 1940).
9. E. L. Atwood and H. S. Pengelly. " Theoretical Naval Architecture," Chap. v. (Longmans).
10. Jack Allen. " Schemes of Improvement for the Cheshire Doe: As Investigated by Means of Model Experiments," Journal Inst.C.E., Vol. 12 (1938-39), p. 30 (June, 1939).
11. Major R. A. Bagnold. " Interim Report on Wave Pressure Research," Journal Inst.C.E., Vol. 12 (1938-39), p. 202 (June, 1939).
12. Professor A. H. Gibson. " Reports on Tidal Model of the Severn Estuary," H.M. Stationery Office, 1933.

*History of the Stockton Ship Channel**

A Notable Californian Enterprise

In the year 1848, in the days of the famous and colourful California Gold Rush, the City of Stockton, which was then known as " Tuleburgh," was the " jumping-off " point to the rich Mother Lode country of the Sierra Nevada mountains.

Around the " Horn " in sailing ships, came thousands of people seeking the wealth of a new country. They soon found that the new life in a virgin land, called for practical methods in every phase of living, and every word and deed reflected their practical viewpoint.

Even the names of their new " diggings " represented actual events and conditions, and to-day we still have the Mother Lode " ghost towns " bearing such practical and plain names as " Shirt Tail Gulch," " Roaring Camp," " Dogtown," " Brandy Flat," " Big Bar," " Drytown," " Hangtown " and many others.

Wisdom and foresight, combined with the practical viewpoint which these pioneers possessed, guided them well in selecting the site where the City and Port of Stockton now stands.

They realised that a location 75 miles inland from San Francisco, in the centre of a vast inland valley, with rich black soil and plenty of water, and served by the large and picturesque San Joaquin River, was the ideal location upon which to build a settlement to serve the Mother Lode area, and at the same time establish the hub for the great agricultural and industrial empire, which they knew would be created in the years to come.

It was only natural that the San Joaquin River should be used as the main artery of transportation in those days, as no roadways or railroads existed, and transportation by horseback was the only method available, other than by water.

As people flocked to California in large numbers, a regular trade by water between California and the Atlantic Seaboard resulted. A colourful era in the history of shipping is recorded at this point, as the fast clipper ships competed for new records for the trip around the " Horn " to California.

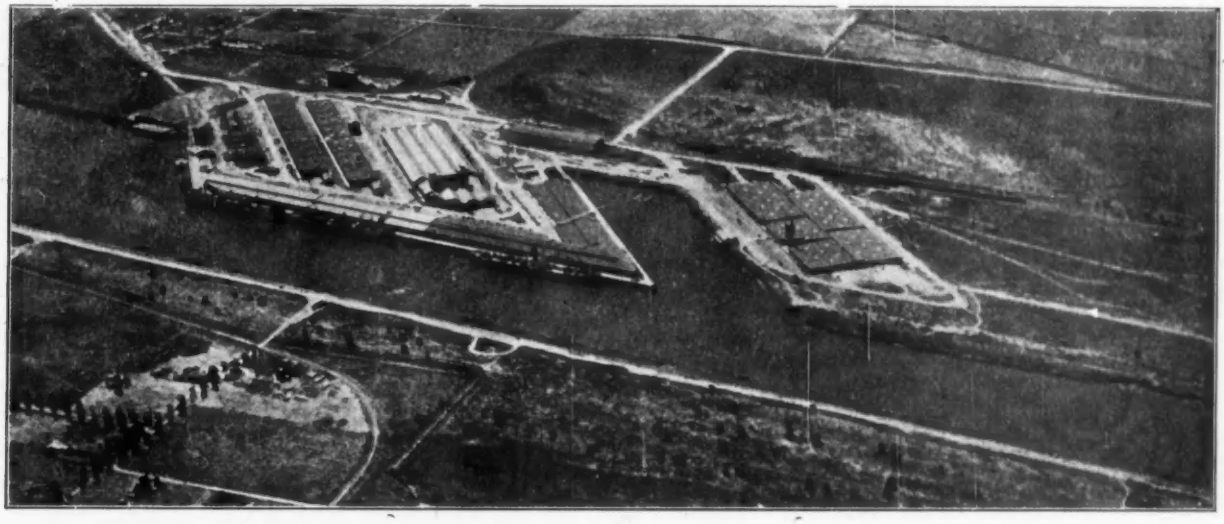
These sailing vessels carried with them the manufactured goods needed in the new territory, and California was a good market with its new-found riches. Soon return loads from California developed, cattle were brought to outward and full cargoes of hides were shipped back to the Atlantic Coast.

These sailing vessels did not require great depth of water, and from 10 to 15-ft. generally permitted safe navigation. The San Joaquin River had sufficient depth for these vessels to call direct to Stockton, which many of them did.

The river was deep and wide to a point approximately 16 miles below Stockton, but these 16 miles were more hazardous, because of many turns and narrowness.

At the same time as ocean sailing vessels were calling at Stockton direct, a development was taking place in the transportation of passengers and supplies between San Francisco and Stockton, with the use of stern-wheelers, copied from those in use on the Mississippi River.

It was not long until trained pilots were available, and while these men learned every turn in the river and could steer a vessel without visibility, using the echo of a whistle as a guide, nevertheless they could not escape the sand bars, which resulted from the heavy spring floods, and the swift currents which built new sand bars and destroyed old ones.



Waterside Front of the Port of Stockton.

Because of these hazards and frequent groundings, many citizens of Stockton at that time spoke of widening and deepening the river, in order that there would be no obstacle to the free development of ocean commerce to and from Stockton. However, no action was taken, due to the lack of civic organisation, the means of financing such a project, and the lack of proper dredging equipment.

So the years rolled by, and as the mining and other business prospered, so did the water carriers with added business volume.

Then came the day when the sailing ships weighed anchor for the last time, and steamships with their speed and size replaced them.

Those last winding and shallow 16 miles to Stockton by river, then proved to be too hazardous for the larger steamships, and Stockton slipped back to a port served only by river craft, not from lack of cargo, but because of 16 miles of river that needed improving.

The passenger boats and shallow draft freight carriers continued to do a large business between San Francisco and Stockton, and while these ships still had difficulty from grounding on band bars, there was one redeeming feature, and that was the nature of the land through which the San Joaquin River found its way. This land was known as " peat land " and it was black and soft and there were no rocks to damage the hull of a vessel in the event it grounded.

The central valleys of California continued to develop in the years following and the production of agricultural products became large as people soon found out that the rich soil, climatic conditions and water conditions made the area one of the richest agricultural valleys in the world. As this development took place, regular and adequate steamship services were established from

*Reproduced from " World Ports."

History of the Stockton Ship Channel—continued

the Pacific Coast with large ocean-going steamships on regular schedule. The agricultural products of the central valleys adjacent to Stockton found a profitable market in other ports of the United States, and in Europe, the Orient and other parts of the world.

The dream of deep water at Stockton had not been lost, but still persisted in the minds of sound thinking citizens as they viewed the movement of the valley products by water, to different parts of the world, and they clearly saw that eventually Stockton must take its place as a world seaport, as economic demands would make this a necessity.

Stockton knew that trans-shipment by shallow draft vessels to San Francisco for transferring to or from the ocean-going vessels, was not a permanent and healthy condition upon which to build the future of the great inland empire, and therefore, agitation among the citizens of Stockton and civic groups continued, for a straighter, wider, and deeper river so that the ocean-going vessels which were calling in San Francisco Bay, could also call at the Port of Stockton direct. Knowing that the whole problem existed is only 16 miles of river, serious programing took place.

After the close of the World War in 1918, the programing began to take shape, and business men and agriculturalists realised that a deep water port at Stockton would mean transportation savings of approximately $1 per ton, as against their costs in moving their cargoes through San Francisco Bay.

After the preparation of many surveys, showing the tonnage volume available, and the value of a deep water port in the heart of California, Maj. U. S. Grant, III who was the U.S. District Engineer, in May of 1924, concurred with recommendations of his predecessor, and made a favourable report to the Government at Washington, recommending the construction of a 24-ft. deep water channel from Stockton westward for about 16 miles, which would eliminate the turns and provide sufficient width so that ocean-going vessels could call at Stockton.

This would provide a tide condition to exist at Stockton of approximately 4-ft., so that navigation would not depend upon flood waters of the mountains to provide sufficient depth, but the tide condition would give a definite and satisfactory depth at all seasons of the year.

After Major Grant's report was submitted, the City of Stockton took another and final economic survey of valley tonnages, and in November of 1924, Major Grant submitted a supplemental report which changed his recommendation from a 24-ft. deep channel to a 26-ft. deep channel.

This was followed by a recommendation from General Harry Taylor in 1925, who was acting as Chief of the U.S. Engineers, which was filed with the Secretary of War, and this clearly showed that the Government interests were involved in the San Joaquin River project, and the recommendation asked that the U.S. Government pay one-half of the dredging costs, provided that the Stockton interests secure the rights of way and that the City of Stockton construct and complete 400-ft. of open wharves and 800-ft. of covered wharves.

A short time later the Congress passed a bill embodying General Taylor's recommendation, and this bill was signed by President Coolidge on January 21st, 1927. In the meantime, the electors of the City of Stockton had approved a bond issue providing for $3,000,000 to construct the necessary wharf facilities.

It took considerable time to secure the rights of way from the land owners along the shores of the proposed ship channel. However, in April, 1930, the actual dredging operations began and by December of 1932, the dream of the early pioneers came to be a realisation. The dredging was completed and there was a deep water port at Stockton which would permit ocean-going vessels to call direct.

The Port of Stockton was officially opened as a deep water port in February of 1933 and it boasted 500-ft. of open wharves, and 800-ft. of covered wharves, as well as three brick warehouses, a belt line railroad and a comprehensive system of water for fire protection.

The Stockton ship channel extended approximately 16 miles directly west, in practically a straight line, eliminating all of the winding turns of the old San Joaquin River, and establishing the minimum depth of 26-ft. at mean low water, as provided in recommendations, with the minimum bottom width of 100-ft.

Immediately upon completion of the new channel, ocean-going vessels began to call at Stockton direct, but it was soon found that while the 26-ft. depth permitted navigation by the coastwise steamships, which were of the smaller variety, the larger intercoastal and offshore ocean vessels did not feel confident in placing their ships at Stockton with a 26-ft. channel to traverse, as many times the drafts of these larger vessels were more than 26-ft., and particularly if sizeable cargoes were to be loaded.

In view of this situation, an application was made to the U.S. Government to further deepen and widen the channel, with the result that by 1934, the Stockton ship channel had been deepened to a minimum depth of 32-ft. and a minimum bottom width of 150-ft. The San Joaquin below the Stockton ship channel had been surveyed and the one or two places which needed dredging were given attention, so that a very safe channel for large vessels now existed from San Francisco Bay to Stockton, a distance of 75 miles.

At this point a fast development took place at Stockton and large ocean steamship carriers, engaged in the intercoastal trade and foreign trade began placing vessels in Stockton direct. During the first year of operation in 1933, the Port of Stockton handled 309,546 tons of cargo, but in 1934 this figure had jumped to 511,100 tons. Since that time, each year has shown increases in the number of ships calling and the tons handled and at the close of 1940, the tonnage moving through the Port of Stockton exceeded 719,000 tons. More than 1,676 large ocean-going vessels have called direct at the Port of Stockton since it opened in 1933 to the end of January, 1941.

In view of the phenomenal development at the Port of Stockton over such a short period of time, the U.S. Government decided to further widen the channel so that at the present time* the minimum bottom width is 225-ft. and the depth of 32-ft. at mean low water is guaranteed, and with a tide condition prevailing, there is no fill-in of a serious nature as there are not fast waters rushing through the river to bring down silt from the mountains.

While this work was being done on the San Joaquin River, the facilities of the Port of Stockton were expanding to take care of the increased tonnage being offered. Nine more brick warehouses were built, the lineal feet of wharfage was increasd to 3,250-ft., all available for the docking of ocean-going vessels, and many specialised facilities were constructed for the handling of volume commodities, such as a bean cleaner, a large Port of Stockton Grain Terminal, with complete cleaning and grading and automatic handling equipment, the Cotton Compress, with adequate machinery for the pressing of high density bales of cotton, two lumber distributing terminals with overhead gantry cranes, cement silos for the handling and distribution of bulk cement, molasses tank for distribution of bulk molasses, and one warehouse devoted to a wool auction, which were first inaugurated in 1940 with much success. In addition to this, an oil terminal was constructed three miles west of the ocean cargo handling terminal, where tanks, pipe lines, and oil refinery were constructed. In the large industrial acreage immediately south of the Port of Stockton ocean terminal, canneries were erected and in other place in the City of Stockton and the central valleys of California, industrial development in the way of canneries and processing plants, took place.

The Stockton ship channel is now considered one of the finest inland waterways in the world to-day. Trained pilots safely guide large vessels to and from Stockton with no fear of groundings, even though 90 per cent. of the navigation is performed at night. The channel is well lighted by some 58 lights in addition to beacons and range lights at strategic points and large ships regularly traverse the channel, discharging and loading cargoes moving between Stockton and Oriental countries, Europe, Gulf of Mexico, Atlantic Coast, Canada, Mexico, Africa, Mediterranean ports and other world ports.

So the dreams and plans of a practical and far-sighted group of gold seekers have developed into one of the leading sea ports in the United States.

*i.e., Pre-war.

The Influence of Harbours upon Inshore Fisheries

By ERIC HARDY, F.Z.S.

Importance of War-Time Fisheries

In normal times when we depend mostly upon deep-sea trawling for our fish supplies, the estuary harbours have no more than a negligible effect upon local fishing returns, but now that so little trawling is possible at sea and the importance of inshore fisheries increased so much that these form the main supply of our flat fish, codling, whiting, and rays, it is opportune to review the effects of a harbour upon the fish in its estuary, particularly in relation to fishermen's accusations about waste oil, refuse dumped from ships, etc. It is true that river pollution seriously interferes with river fish, but so far as harbour authorities are concerned, there is little truth in many of the accusations against them. But the subject is important, because river estuaries are often important trawling grounds, for their fresh water, and the cold spring waters when the inland snows melt on the mountains, encourage an abundance of shrimps and crabs which in turn attract an abundance of skates, rays, gurnards and cods which prey upon the crustaceans. This can be seen at the Mersey mouth, for instance.

The Mersey Fisheries

The Mersey is probably the most polluted river in the world, but 24 species of fish continue to visit it and 29 others have been found on rare occasions. It is regularly inhabited by congers, codling, whiting, flounder, grey mullet and at the mouth by tope, plaice, brill, dab, sole, dog fish, thornback ray, etc., while salmon, whiting, sprats, smelts, flounders and congers occasionally ascend 15 miles to the tidal limit at Warrington on high water, although the former are invariably poisoned by the state of the water. There was once a good shrimp fishery in the Mersey off Hale and Eastham Locks, but this is now very small, and small fishing boats, which earlier this century fished the river off Dingle, Tranmere Bay and Eastham Locks, now go down to the mouth at New Brighton. But the Rock Channel at the river mouth is still a very good trawling ground, and in May, 1942, a Wallasey boatman caught £50 worth of fish in a single trip—18 boxes of plaice, rays, soles, brill and turbot. At high water, years ago, one could catch congers and flounders on lines at the shore at Fulwood Park and Dingle Point, or St. Michael's, but this has gone off in recent years, although grey mullet still visit Morpeth Dock and Birkenhead Float in summer, which, like the Gladstone Dock at Bootle, give good fishing, mostly flounder, occasionally codlings, soles, whiting and eels, especially in water sheltered by berthed vessels, or from the sea wall, and as much as ten pounds of fish may be had in an hour on hand lines. New Brighton fishing boats still manage, on occasion, to trawl fish off Liverpool Pier Head and the Salisbury Dock.

The Mersey mouth at New Brighton once had one of the biggest winter line fisheries for cod in the country with 1,600 hooks on a line, but the big lines now have about 300 hooks, yet only a few years ago the biggest flounder on record for Britain was caught there, and it still has good shore fishing for tope up to 50 lbs., whiting of 3 to 4 lbs., flounder and plaice of about half-a-pound, congers up to 4 lbs., codling 3 to 5 lbs., etc., but the fishing has definitely deteriorated in recent years owing to the pollution, most of which comes from Widnes and other towns above Liverpool, and not from the dock estate. Where adequate precautions are taken against waste oil discharge, this will not be a serious menace, but there have, on occasions, even before the war, been extensive areas of surface oil on the Mersey Estuary. Surface oil has a destructive effect upon floating fish eggs and the plankton food of fishes, but the late Professor J. Johnstone, of Liverpool, a leading authority on marine fishes, pointed out that this danger to fisheries is not likely to be more than local. Even the coastal waters of Liverpool Bay are so enormous in area that a very great volume of fuel oil would be necessary to affect them to such an extent as to be prejudicial to fish fry and their food. He laid more stress upon the effects of chemical and industrial pollution, and the dumping of explosives in the sea.

Effect of River Pollution

The amount of pollution a river can carry, without seriously affecting its fish-life, depends upon the strength and depth of the currents, for even the Severn mouth, which is very polluted, does not prevent thousands of Wye salmon ascending every year at high water when the pollution is diluted, but it is doubtful if salmon can pass through much of the Severn in low summer and autumn water. The fish of the Thames Estuary at Leigh-on-Sea include 15 species of flat fish, 11 of the cod tribe, 6 of the herring tribe, frequent sea trout and sturgeons, and occasional rarities, like swordfish, pilot fish and even the flying fish, have been taken. Since the last war freshwater fish, such as trout, roach, carp, pike, dace, bream, eels and sticklebacks have been caught in the London docks.

I don't think the presence of a harbour has so much effect upon local fish distribution as has the nature of the sea bed, for where there are extensive mud banks, as at the estuaries of the Mersey, Ribble and Lune, vast numbers of young flat fish become resident, until they reach maturity, and these estuaries become veritable fish nurseries. The Mersey Estuary has yielded more than 14,000 young plaice in a single haul of a shrimp net, and there have been hauls of over 3,000 young whiting. The cessation of visits of shoals of herring to the Mersey in the past 30 years is due to the varying influxes of the warm Atlantic Gulf water into the Irish Sea rather than to the development of the port.

But the fishing industry depends very much upon the facilities afforded it at the local port, and it was very much to be regretted that shortly before the war, attempts to make Liverpool a fishery port fell through and were finally abandoned, although a small fleet of steam trawlers had worked from the Canning Dock for years.

Influence of Harbour Structures

Harbour installations will sometimes attract fish not previously in the river. These are usually the vegetarian grey mullet which are attracted to browse upon the algae grown on the piles on the bottoms of barges in the Thames and other waters, and which have been attracted to Birkenhead Docks by the grain mills and warehouses. The construction of a pier or breakwater is a distinct advantage to shore-line fishing and rod fishing and far more, and heavier, fish are caught by fishing from these places because they are in deeper water. It is unfortunate that many harbour authorities have placed war-time restrictions upon fishing from their dock walls and jetties at high water. Many fish are found in Birkenhead docks where the drainage from the lairages for imported Irish cattle attract them, and here was caught the biggest lobster in the collection at Liverpool University, over 2-ft. long.

Research at Liverpool and elsewhere has shown that the periodic variations in the numbers of fish, like plaice, codling, soles and whiting caught in a river mouth are influenced more by local migrations of the fishes than by the influences of the ports as inshore fishermen allege. There are also physical causes like temperature, salinity, chemical substances naturally in sea water, the abundance and movements of algae and diatoms (the plankton food of fish) in relation to solar energy and surface currents, and these physical causes vary from year to year so that several fish, plaice, for instance, may be relatively abundant for several years and then may come a period of relative scarcity.

Apart from waste oil, and in so far as the local harbour authorities control sewage discharge into the river, harbour installations do not have any appreciable effect upon local fisheries, but in many cases they have been more concerned with the effects of river pollution upon the formation and stabilisation of mud banks, than upon fish life, and the costly investigation of the effects of pollution in the Mersey Estuary carried out before the war by the Department of Scientific and Industrial Research seems to have centred mostly on the former problem to the neglect of the latter.

Projected Expansion of Marseilles Harbour.

It has been announced on Vichy Radio that the harbour at Marseilles is to be extensively enlarged in the near future. Whether this refers to an entirely new programme of works, or to the approaching completion of the elaborate scheme of port development which has been in hand for some time is not clear from the announcement, which states that "moles, docks and other harbour installations will be built."

Wreck Control in Harbour Waters

There has been issued by the Ministry of Transport, a new Order in reference to the removal of wrecks from harbour waters. This Order (S.R. and O 1943, No. 223) takes the place of a previous Order (S.R. and O. 1941, No. 1315) and gives extended powers for the prompt removal, without previous notice, of obstacles to navigation, including both vessels and aircraft, sunk, stranded or abandoned. Under the new Order the powers, hitherto vested in a dock or harbour undertaking, can be exercised by other public utility undertakings, as for example, Trinity House and lighthouse authorities.

The following is the text of the new Order:

The Minister of War Transport in exercise of the powers conferred upon him by Regulation 56 of the Defence (General) Regulations 1939 (having been duly designated by the Treasury as a competent authority for the purpose in relation to lighthouse undertakings), and of all other powers enabling him in that behalf, hereby makes the following Order:—

1. The obligations and limitations imposed, with respect to any dock, harbour, lighthouse, canal or inland navigation undertaking, by, or by virtue of any Act or other instrument determining the functions of the undertakers, in relation to vessels and aircraft sunk, stranded or abandoned, or to any property recovered therefrom or to any other wreck or obstruction or danger to navigation or to the recovery from any person of all or any of the expenses incurred by the undertakers in dealing therewith, shall be relaxed to the extent specified in the next following Article of this Order.

2. Every such obligation or limitation shall cease to have effect, if, and in so far, the undertakers are thereby required to publish or to give notice of the exercise or intended exercise of any of their rights or powers or to obtain the consent thereto of any other person.

Provided that nothing in this Article shall be taken to apply to any obligation or limitation imposed by the proviso to Section 530 of the Merchant Shipping Act, 1894.

3. The provisions of this Order shall apply in relation to any part of a vessel or aircraft and to anything being or forming part of the machinery, tackle, equipment, cargo, stores or ballast of a vessel or aircraft as they apply in relation to vessels and aircraft.

4. The Dock and Harbour Undertakings (Control of Wrecks and Other Obstructions) Order, 1941, is hereby revoked.

5. This Order shall come into force on the twenty-second day of February, 1943. and may be cited as the Public Utility Undertakings (Control of Wrecks, etc.), Order 1943.

Tyne Improvement Commission Affairs

In presenting the accounts of the Commissioners at the meeting of the Board on March 16th, Mr. W. A. Souter, Chairman of the Finance Committee of the Tyne Improvement Commission reported that after meeting all expenditure and making full provision for interest charges and loan redemption (£121,000) in accordance with statutory requirements, the Commissioners have a deficit for the year of £38,834 a result which is considered far from unsatisfactory in view of the fact that loan debt has been reduced during the year by £84,930.

In his remarks to the Commissioners, Mr. Souter pointed out that the strong financial position of the Commission remained unimpaired after 3½ years of war. The results achieved in regard to a renewal of loans and taking up of new money were a testimony of the high appreciation in which the Commissioners' securities are held by a gradually widening circle of investors.

In dealing with the Commissioners' Ferries, on which during the year there was a deficit of £7,349, bringing the accumulated deficit on that account to £18,000, Mr. Souter reminded the Board of the active steps taken to endeavour to remedy the position of the Ferries. He regretted that after the protracted negotiations with the two Harbour Boroughs, which culminated in an agreement on an increase in the tolls and on certain savings in expenditure, that the necessary sanction from the Ministry of War Transport has not been received. The Ministry, he said, have been reminded by letter and by telegram of the urgency of the matter. Mr. Souter deplored the delay, particularly when public monies are at stake and the loss on the ferries continues.

In referring to War Damage, Mr. Souter emphasised the justice and necessity of the liability for 50 per cent. of the aggregate war damage which the United Kingdom Ports are at the outset to be asked by H.M. Government to bear being substantially reduced—more especially as the United Kingdom Ports have been picked out by the enemy as special objects of attack.

In concluding his remarks, Mr. Souter referred very briefly to the post-war problems of the country and in particular to the speech by the Chairman of the Executive Committee of the Dock and Harbour Authorities' Association when he intimated that there is on foot a plan which originated amongst officials of the Ministry of War Transport to create a central organisation to control the docks and harbours of the country. Mr. Souter felt that if ever the dead hand of centralised or regional authority were superimposed upon Bodies like the Tyne Commission it would inevitably mean a lessening of the lively and intelligent interest taken by the Commissioners. If the delay, he said, which we have experienced in connection with the Ferry Undertaking is an example, and he was afraid it was, he viewed with apprehension the effect of such control upon the Commissioners' activities. Mr. Souter referred to the development of the Tyne under local initiative and called for an attitude of "leave us alone to manage our own affairs."

Notes on Drag-Suction Dredging

(concluded from page 279)

with reserve pumps for the simultaneous service during all the manœuvres inherent in the dredging, amplitude in the dimensions of the propeller shafts and the dredging pumps, automatic safeguards against seizing of the impellers, installation of *ad hoc* pumping for the injection of low pressure water during working and discharging and fire service.

Lastly, one must consider the services essential to proper life on board of the engineers, officers and crew, viz.: ample quarters, properly ventilated and lighted, electric and refrigerating plant, radiotelegraph and the provision of auxiliary vessels such as launches, boats, etc. The requirements in this respect ought to be the subject of a detailed analysis which cannot be included in this general statement; all that is aimed at is to indicate summarily the conditions required in order that the type of dredger being studied shall respond technically and economically to the ends proposed.

Port of London Authority.

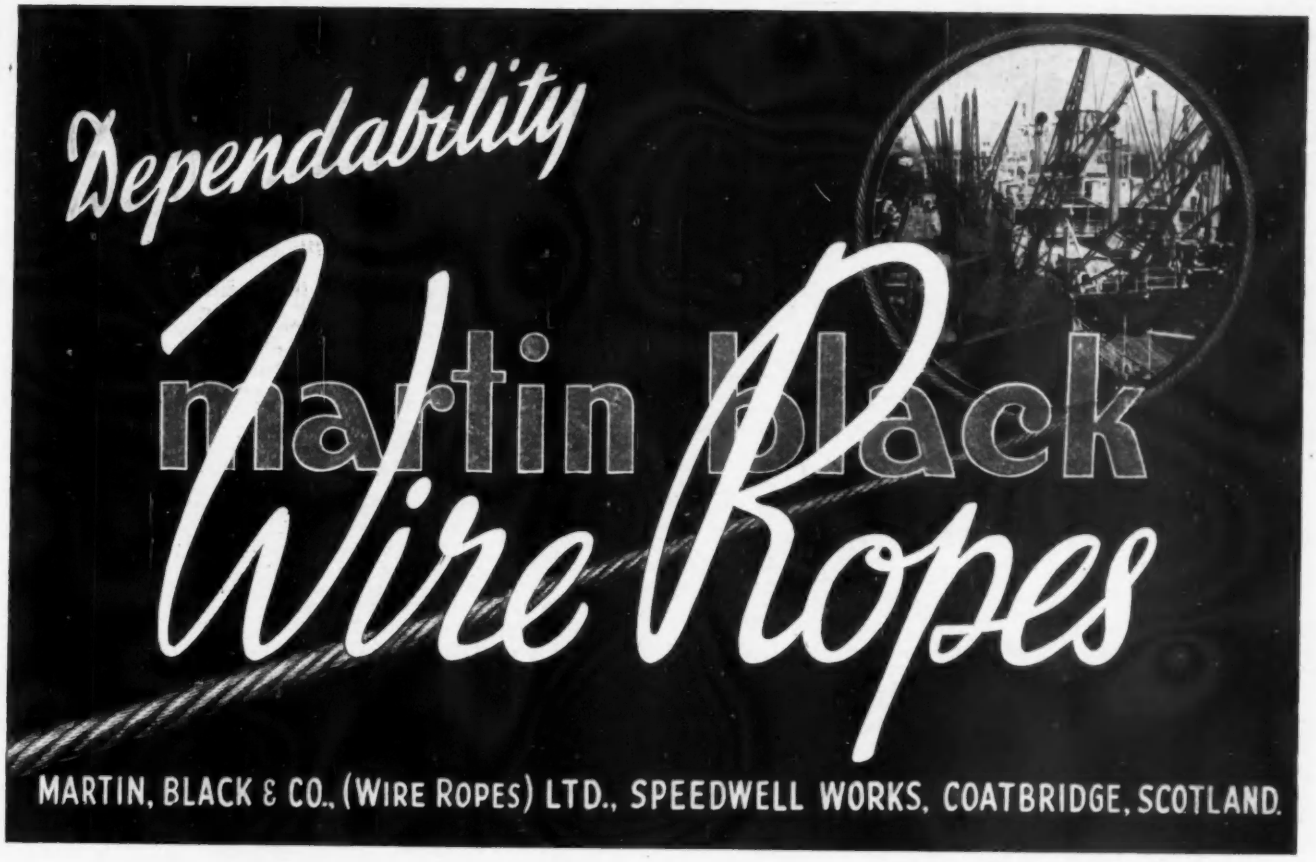
Captain A. H. Ryley has been appointed a Member of the Port of London Authority by the Corporation of Trinity House in succession to Captain P. N. Layton, C.B.E., R.D., whose resignation was recently announced.

The death, at the age of 85, has been announced of Sir John Ontario Miller, K.C.S.I. He was a member of the Port Authority from 1916 to 1925 as a representative of the London County Council.

The death has also occurred, in his 79th year, of Mr. Frank Ayliffe, who was Secretary to the Authority from 1910 until his retirement in January, 1927. Previously, he was in the service of the Thames Conservancy and, on the merging of jurisdiction in that of the Port Authority, he became River Superintendent.

Death of Veteran Dockers' Leader.

The death at the end of January of Mr. Ben Tillett, former Labour Member of Parliament, removes from the scene a notable leader of the dockers, who was prominently in the public eye as far back as 1889, when he led an agitation for better working conditions and a minimum wage of 6d. an hour. The strike which he then organised paralysed traffic in the port of London. Subsequently he continued in office as general secretary of the Dockers' Union until 1921, when the Union was merged in the Transport and General Workers' Union. At the same time, he was elected to the General Council of the Trades Union Congress and in 1928-29, he was its chairman. He represented North Salford in the House of Commons from 1917 to 1924 and again in 1929. He has died at the age of 82.



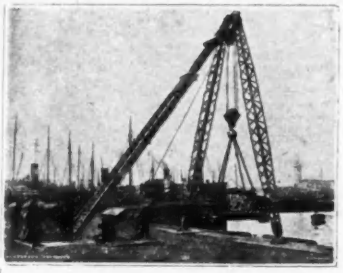
DIVING APPARATUS OF ALL PATTERNS.

SMOKE HELMETS
for Steamships, Docks, Tankers, etc,

GAS MASKS for Naval, Military, Industrial and Civilian purposes.

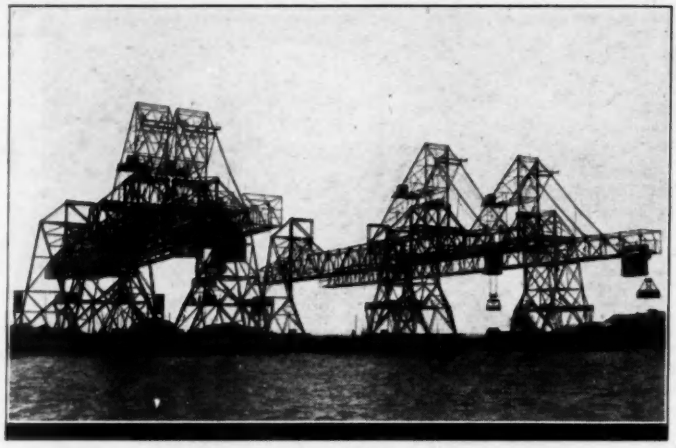
OXYGEN RESUSCITATING APPARATUS for the apparently drowned or asphyxiated.

SIEBE, GORMAN & CO., LTD
LONDON



25-Tons Shear Legs at a Scottish Harbour.

TELEGRAMS "Cranes, Aberdeen" | LONDON OFFICE 12, Norfolk Street, Strand, W.C.2 | JOHN M HENDERSON & Co Ltd KING'S WORKS ABERDEEN



We specialise in all kinds of lifting and handling appliances for steelworks, shipyards, harbours, docks and general purposes.

Clyde Cranes insure quicker turnround and quicker "turnround" insures more available shipping tonnage.

CLYDE CRANES

CLYDE CRANE & ENG. CO.
CLYDE CRANE WORKS
MOSSEND, SCOTLAND

The following is a List of a few of the Books in

THE DOCK & HARBOUR AUTHORITIES' LIBRARY

Postages on all these books are extra, and vary according to the country for which they are required. Postage rates can be had on request.

THE IMPORTERS HANDBOOK.—By J. A. Dunnage. Price 10/-.

MARINE WORKS.—By Ernest Latham, M.Inst.C.E. Price 16/-.

DOCK AND LOCK MACHINERY.—By W. H. Hunter, M.Inst.C.E. Price 17/-.

CONCRETE STRUCTURES IN MARINE WORK.—By R. Stroyer, B.Sc., M.Inst.C.E., M.I.Mech.E. Price 15/-.

THE DESIGN, CONSTRUCTION AND MAINTENANCE OF DOCKS, WHARVES AND PIERS. By F. M. Du-Plat-Taylor, M.Inst.C.E. Price 45/-.

THE RECLAMATION OF LAND FROM THE SEA.—By F. M. Du-Plat-Taylor, M.Inst.C.E. Price 21/-.

MODERN HARBOURS.—Conservancy and Operations.—By E. C. Shankland. Price 21/-.

DREDGING OF HARBOURS AND RIVERS.—By E. C. Shankland. Price 42/-.

REINFORCED CONCRETE PILING.—By Wentworth-Sheilds and Gray. Price 8/6.

BOOKS by BRYSSON CUNNINGHAM, D.Sc., B.E., F.R.S.E., M.Inst.C.E.

PORT ADMINISTRATION & OPERATION. Price 15/-.

CARGO HANDLING AT PORTS. Price 15/-.

HARBOUR ENGINEERING. Price 30/-.

THE DOCK & HARBOUR ENGINEER'S REFERENCE BOOK. Price 10/-.

PORT STUDIES. Price 25/-. **PORT ECONOMICS.** Price 5/-. **DOCK ENGINEERING.** Price 42/-.

The above prices are subject to revision.

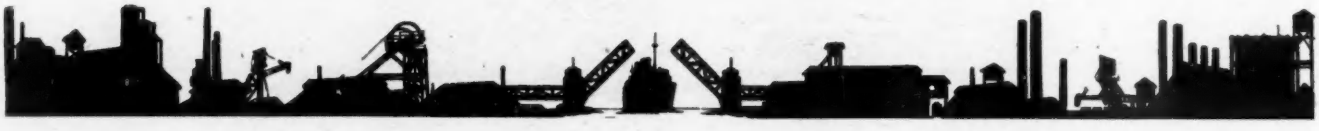
THE DOCK & HARBOUR AUTHORITY

17-19, Harcourt Street, London, W.1.

HEAD, WRIGHTSON & Co LTD

THORNABY-ON-TEES

FOR CONSTRUCTIONAL, MECHANICAL
AND CIVIL ENGINEERING
IRON, STEEL AND ALLOY CASTINGS
AND DROP FORGINGS



MANŒUVRABILITY

It's here, there and everywhere.

It operates in a flash.

It keeps everlastingly at it.

This Two-tons Diesel Electric Mobile Crane is an ideal Machine.

B.R. Wire Ropes are fitted to it — Ropes that help it to maintain its high reputation for Durability and Reliability,

We are indebted to Messrs. Thomas Smith & Sons (Rodley) Ltd., for the loan of this illustration and for permission to reproduce it.

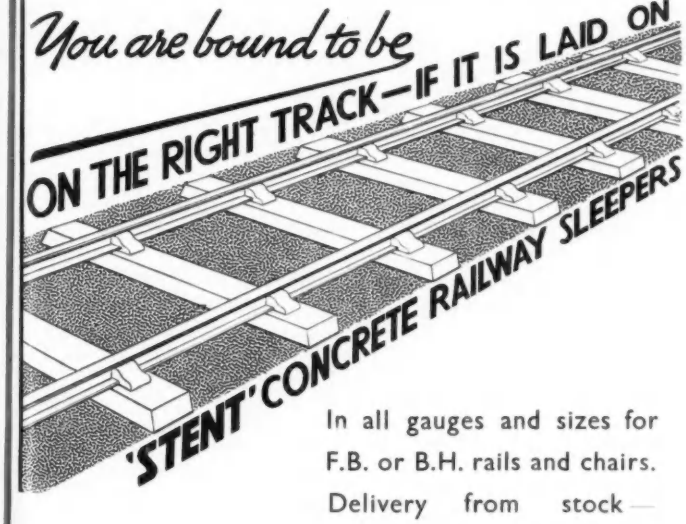
Manufacturers of Wire Ropes, Hemp Cordage, and Wire

BRITISH ROPES *Limited*

HEAD OFFICE: DONCASTER. Offices and Works throughout Great Britain

You are bound to be

ON THE RIGHT TRACK—IF IT IS LAID ON



'STENT' CONCRETE RAILWAY SLEEPERS

In all gauges and sizes for F.B. or B.H. rails and chairs. Delivery from stock — Also Clips and fastenings.

PROFIT BY OUR 25 YEARS EXPERIENCE.

ANYTHING AND EVERYTHING IN PRECAST CONCRETE

STENT PRECAST CONCRETE LTD
1 VICTORIA ST LONDON SW1
TELEPHONE · WHITEHALL 2573
WORKS IN ESSEX · SURREY · MIDDLESEX · HAMPSHIRE

Every Minute Counts

Every working minute saved brings the day of Victory nearer. In the production of essential supplies

GLEDHILL-BROOK TIME RECORDERS

are playing an important part

Write now for particulars of available equipment and maintenance service.

Dept. 46, Empire Works, Huddersfield

From LIGHTERS to LINERS

Another Step Forward By Lobnitz !

A sea-board country without a port would be like a shop without a door ; its imports and exports which should flow in a steady stream would just come and go in trickles—a very irritating state of affairs for an enterprising country.

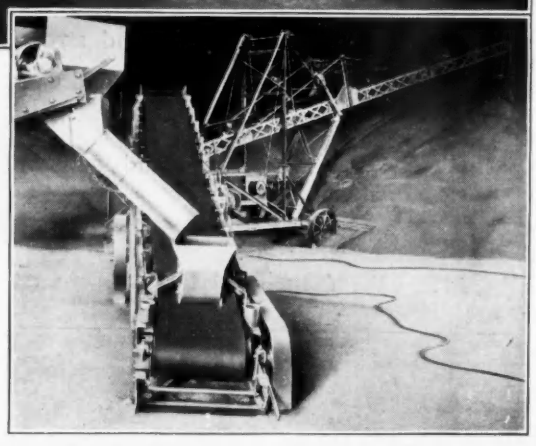
But in many corners of the world—where ships once unloaded within mere sight of land and lighters fetched and carried ; where landing a cargo was a week's work—merchant liners are today alongside the new walls of new docks of countries which are finding new trade and new prosperity.

No miracle of Nature but a plain saga of hard work and efficient dredging by the sturdiest and most efficient dredges in the world. Sand and silt were disposed of, rocks and river-bed conglomerate were thrown out clear and a huge harbour carved out of the raw—Lobnitz have been there !

Get in touch with Renfrew and lay *your* plans for the future.

LOBNITZ
THE NAME TO REMEMBER IN DREDGING
& CO. LTD. RENFREW, SCOTLAND.
PHONE – 2004

PORTABLE GRAIN DISCHARGING MACHINERY



These Mobile Grain Pneumatic Discharging plants of 40-tons per hour capacity, and the sets of Portable Conveyors, Pilers and Excavators were manufactured by us recently to the order of Ministry of Works and Planning for use at the numerous inland grain stores they have constructed.

HENRY SIMON LTD.,
CHEADLE HEATH STOCKPORT.

Printed by Ward & Foxlow, Ltd., and Published by the Foxlow Publications, Ltd., at 19, Harcourt Street, London, W.1.

8616 50 G